STATUS OF FORESTS IN TAMIL NADU

ANALYSIS OF THE INDIA STATE OF FOREST REPORTS 2001-2021

TAMIL NADU STATE LAND USE RESEARCH BOARD
STATE PLANNING COMMISSION

STATUS OF FORESTS IN TAMIL NADU

ANALYSIS OF THE
INDIA STATE OF FOREST REPORTS
2001 - 2021

Report by

Tamil Nadu State Land Use Research Board

State Planning Commission

Published by

Tamil Nadu State Land Use Research Board,

State Planning Commission,

Ezhilagam, Chennai

March 2023

Contributors

Sudha S IFS, Member Secretary (FAC) /
Head of Division Land Use, State Planning Commission

G. Benita Tresa, Research Associate

V. Nishalini, Senior Research Fellow

Support

S. Govindaraju, Planning Officer

R. Radha, Technical Assistant

J. Durgadevi, Technical Assistant

E. Vasumathi, Planning Assistant

Foreword

For the continued existence of life on Earth, forests and trees are regarded as essential resources. The forest and tree cover of Tamil Nadu is now about 30,843.23 sq km which constitutes 23.71% of the total geographical area. The state is taking up all efforts to reach its objective of 33% of green cover before 2030. Encompassing the ecological, economic, and social dimensions of the Tamil Nadu's growth model, it is necessary to have a monitoring mechanism that would also carry out periodical assessment of forest resources that contributes in protecting biodiversity, mitigating climate change, and supporting sustainable development.

The Tamil Nadu State Land Use Research Board (TNSLURB), under the State Planning Commission has undertaken a study on "Status of Forests in Tamil Nadu – Analysis of the India State of Forest Report 2001 – 2021" for the first time in the state, to carry out temporal analysis of Tamil Nadu's Forest. The data and analysis from this report would serve as critical inputs for policy making in the forestry sector of Tamil Nadu.

The result of this study, from a policy perspective, is therefore imperative that the forest and tree cover should be regularly monitored at the state and district level. The outcome of this analysis has identified the primary areas and regions in which efforts can be initiated to improve the forest cover thereby contributing to the conservation of biodiversity and other forest resources. This is one among the many important efforts by the State Planning Commission and the TNSLURB to strengthen the importance in understanding and managing the Tamil Nadu forests as valuable natural resource and ecosystems, and for ensuring their long-term sustainability.

J. Jeyaranjan,
Vice Chairman, Tamil Nadu
State Planning Commission

STATUS OF FORESTS IN TAMIL NADU

ANALYSIS OF THE INDIA STATE OF FORESTS REPORTS

2001 - 2021

CONTENTS

ABSTRACT **9**

1. INTRODUCTION 11

2. OVERVIEW OF FORESTS IN TAMIL NADU 19

3. ANALYSIS ON THE FOREST COVER 24

4. VARIATIONS IN THE DENSITY CLASSES OF FOREST COVER 36

5. ANALYSIS ON THE RECORDED FOREST AREA 51

6. ANALYSIS ON THE TREE COVER OF THE STATE 56

7. ANALYSIS ON THE MANGROVE COVER 61

8. DISTRICT WISE ANALYSIS OF THE FOREST COVER 69

1. Ariyalur 70
2. Chennai 74
3. Coimbatore 78
4. Erode 82
5. Tiruppur 86
6. Cuddalore 90
7. Dharmapuri 94
8. Krishnagiri 98
9. Dindigul 102
10. Kancheepuram 106
11. Kanyakumari 110
12. Karur 114
13. Madurai 118
14. Nagapattinam 122

15. Namakkal 126
16. Perambalur 130
17. Pudukkottai 134
18. Ramanathapuram 138
19. Salem 142
20. Sivagangai 146
21. Thanjavur 150
22. The Nilgiris 154
23. Theni 158
24. Thiruvallur 162
25. Tiruvarur 166
26. Tiruchirapalli 170
27. Tirunelveli 174
28. Tiruvannamalai 178
29. Thoothukudi 182
30. Vellore 186
31. Villupuram 190
32. Virudhunagar 194

9. SUMMARY 198

10. DISCUSSIONS & WAY FORWARD 205

11. APPENDIX 210

REFERENCES 220

GLOSSARY 221

List of Tables

Table 1.1: Overview of spatial data used by FSI to generate ISFR

Table 2.1: Decadal Overview of Tamil Nadu

Table 2.2: Land Use classification of Tamil Nadu

Table 3.1: Forest Cover of Tamil Nadu since 2001 (ISFR)

Table 3.2: Comparison of India's forest cover and Tamil Nadu's Forest cover since 2001

Table 3.3: Comparison of forest cover in the districts of TN between 2001 and 2021

Table 3.4: Forest cover within and outside recorded forest area in TN

Table 4.1: Forest Cover Area of Tamil Nadu from 2003 - 2021

Table 4.2: Very Dense Forest Area of districts in Tamil Nadu

Table 4.3: Moderately Dense Forest Area of districts in Tamil Nadu

Table 4.4: Open Forest Area of districts in Tamil Nadu

Table 4.5: Districts that Lost Forest Cover

Table 4.6 Trend analysis of selected districts that had lost area in any one of the density classes

Table 5.1: Recorded Forest area in Tamil Nadu

Table 5.2: Recorded Forest area and forest cover area in Tamil Nadu

Table 6.1: Tree & Forest Cover in Tamil Nadu with respect to Total Geographical Area

Table 7.1: District wise Mangrove cover in Tamil Nadu

Table 7.2: Major and minor mangrove wetlands of Tamil Nadu

Table 7.3: Mangrove cover of India

Table 7.4: Mangrove density classes of Tamil Nadu

Table 7.5: Mangrove distribution in Tamil Nadu

Table 8.x: Districts wise analysis of the forest cover (x= 1 to 32)

Table 9.1: Overview on Forest Cover classification in Tamil Nadu districts

Table 9.2: Classification of districts by total forest cover area

Table 9.3: Recorded Forest area and total forest cover area in the districts of Tamil Nadu

Table 9.4: Districts and the density class that require attention

List of Figures

Figure 1. 1: Forest terminologies used in ISFR

Figure 2.1: Overview of forest and non-forest area in TN (ISFR 2021)

Figure 3.1: Notified Forest area of Tamil Nadu

Figure 3.2: Forest Cover map of Tamil Nadu

Figure 3.3. Comparison of forest cover in the districts of TN between 2001 and 2021

Figure 3.4. Top 5 districts that lost and gained forest cover since 2001

Figure 3.5: Districts with highest and lowest forest cover (ISFR 2021)

Figure 3.6: Overview of Forest cover within and outside recorded forest area in TN

Figure 4.1: Types of land cover (Forest and Non-Forest)

Figure 4.2 Districts ranked according to forest cover classes

Figure 4.3 District`s rank according to forest loss

Figure 5.1: Recorded Forest area and forest cover area in Tamil Nadu

Figure 6.1: Tree Cover, Forest Cover and Forest cum tree cover

Figure 6.2: Net change in forest cover and tree cover

Figure 7.1 Mangrove Forest

Figure 7.2: Mangroves in Tamil Nadu

Figure 7.3: Mangrove density classes trend in Tamil Nadu

Figure 7.4: District wise Trend Analysis of Mangrove density classes

Figure 8.1 Districts of Tamil Nadu (2023)

Figure 8.x.1: Trend analysis of Forest Cover for each of the 32 districts (x = 1 to 32)

Figure 8.x.2: Share of Forest and non forest area in each of the 32 districts (x = 1 to 32)

Appendix : Forest cover map of Tamil Nadu from 2001 to 2021

ABSTRACT

Forests and trees are considered as a vital resource for the existence of life on earth. Evaluating the extend of forests and assessing the tree cover outside the forest along with monitoring its status is important to ensure the sustainable development of the country and to know the prospective economical potential of the trees outside the forest in addition to the environmental benefits they render. Though trees have largely contributed to the "Green Economy" of the country and several states, they continue to contribute in terms of ecosystem services whose value would run into several millions. There is need for continuous assessment of the forest and tree cover of the state in order to ensure the continued services of the forests and the trees. Forest Survey of India publishes India State Forest Report (ISFR) once in two years which provides information on forest cover, tree cover, mangrove cover, growing stock, carbon stock in India's forests, and other details like forest fire, biomass etc.,

The aim of this report is to analyze the data pertained to Tamil Nadu in the ISFR published from 2001 to 2021 so as to assess the status of the forest in Tamil Nadu and to capture the changes in the forest cover. The analysis is done at two levels – state and district level at multiple dimensions that include the variations in the density classes, mangrove forests, recorded forest area vs forest cover and tree outside forest. The outcome of this assessment will help the State to identify the focal areas and points where efforts can be taken up to increase the forest and tree cover.

1. INTRODUCTION

Tamil Nadu is endowed with rich biodiversity, from marine coastal systems in the Gulf of Mannar to the terrestrial evergreen forests in the Western Ghats and temperate forests in the hilly regions. As per the Champion & Seth Classification of Forest Types (1968), the forests in Tamil Nadu belong to nine Forest Type Groups, which are further divided into 39 Forest Types. The Nilgiris Biosphere Reserve represents a unique and threatened ecosystem in the tropics inside the Western Ghats Mountain system and is one of the biodiversity hotspots. Tamil Nadu has been a pioneer State in the biodiversity conservation, particularly in Protected Area management, including conservation of marine fauna.

The state has been focussing constantly on increasing the tree cover outside the forest area through many schemes that encourages people to raise valuable forest tree species in their farm lands and common lands. The state was famous for its Teak and Sandalwood forests during the late 1980's and 1990's. Plantations of Sandalwood, conservation and management of mangroves and wetlands have also been one of the priorities to the State Forest Department.

Over the past few years, the state has witnessed several changes in terms of urbanization, industrial developments, wildlife habitat fragmentation due to the developments of new linear structures like roads and railway tracks, an increase in human habitations around the forest fringe areas and many more, that has grossly affected and altered the forest and tree cover of the state. This report analyses the change in the forest and tree cover of the state between 2001 and 2021 based on the Indian State of Forest Report published by Forest Survey of India. The observations of report will help the State Government to understand the change in terms of Forest and tree cover in the recent past and will help to prioritize the schemes like Green Tamil Nadu Mission and other schemes related to tree planting in the districts that have less forest cover. Such interventions will help the state in achieving the target of having 33% of the geographical area under green cover at the earliest possible.

1.1 AIM AND OBJECTIVES

The aim of this report is to bring out the two decadal changes in the forest cover, tree cover and mangroves forest from 2001 to 2021 timeframe in the state of Tamil Nadu, using the data published by Forest Survey of India through the Indian State of Forest Reports.

The objectives of the assessment are:

- To detect the changes in forest cover area, tree cover area and the mangrove areas of Tamil Nadu over the period of twenty years between 2001 and 2021.
- To detect the changes in terms of forest cover at district level and to identify the priority districts to increase its tree cover.
- To have a detailed analysis of the variations in the 4 categories of the forest at the district level (very dense, moderately dense, open forest and scrub)

1.2 DATA USED

India State of Forest Report

The National Forest Policy of India, 1988 envisaged a goal of achieving 33% of the geographical area of the country under forest & tree cover. The remote sensing based nation-wide Forest Cover mapping at biennial interval, serves as a monitoring mechanism towards achievement of this goal. Periodic forest cover assessment at definite intervals helps in assessing the status of forests in the country and its broad trend.

India State of Forest Report (ISFR) is a biennial publication of Forest Survey of India (FSI), an organization under the Ministry of Environment, Forest & Climate Change, Government of India. It is a widely used primary information source across the Central Government, State Governments and forestry professionals of the State Forest Departments, academia, international organisations, and other stakeholders. These inputs about the forest resources of the country are used for broad evaluation and formulation of forest related policies, programmes, legislations, and other related activities.

The principal mandate of the Forest Survey of India (FSI) is to conduct survey and assessment of forest resources in the country. It started as an organization called Pre-Investment Survey of Forest Resources (PISFR) in 1965 as Food and Agriculture Organisation of the United Nations (FAO)/United Nations Development Programme (UNDP)/ Government of India Project. The changing information needs resulted in enlarging the scope of activities of PISFR and it was re-organized as Forest Survey of India in 1981.

Initially, FSI assessed the forest resources in different parts of the country through ground inventory and interpretation of aerial photographs. However, since the early eighties, it started using satellite data to assess the forest cover of the country. As per its revised

mandate of 1986, FSI has to assess forest cover of the country on a two-year cycle and to publish the information in the form of "State of Forest Report" (SFR). Its first assessment was published as SFR 1987. The latest report, ISFR 2021 is 17th in the series. Over these years, successive reports present a continuous, comprehensive, and comparative picture of India's forest and tree resources over time.

Steady improvements have been made in the forest cover assessments for the preparation of each report by employing latest data with higher resolution and scale, with more intensive coverage under ground verification and by using superior techniques of interpretation. The first report of 1987 used LANDSAT-MSS satellite data with a spatial resolution of 80 meters, the scale of mapping was 1:1 million and interpretation was in visual mode with a Minimum Mappable Unit (MMU) of 400 hectares. Subsequently there were continuous improvements in the spatial resolution of satellite data and scale of mapping and MMU. With the availability of indigenous satellite data from 1995 onwards, FSI started using the IRS-1B satellite data and in 2001 completely switched over to LISS III data with a spatial resolution of 23.5 m at 1:50,000 scale with MMU of 1 ha. The mode of interpretation also changed to digital mode.

1.3 CRITERIA ASSESSED

Temporal analysis of the following criteria is done with the data from ISFR (Figure 1.1)2001 to 2021. Some of these variables are also analysed with respect to the districts of Tamil Nadu.

1. Forest Cover
2. Density classes of the Forest – very dense forest, moderately dense forest, open forest and scrub
3. Recorded forest area and forest cover
4. Tree Cover
5. Mangrove cover

In order to have a better understanding of the findings of this analysis, the terminologies listed above should be understood prima-facie. This section of the report explains about each of these variables in the same context as that of the ISFR.

1. Forest

A forest is generally defined as a plant community predominantly of trees and other woody vegetation. Food and Agriculture Organisation of United Nations (FAO) defines forest as land with a tree canopy cover of more than 10% and area of more than 0.5 ha. Forest is

determined not only by presence of trees but also by the absence of other predominant land uses. Thus, according to FAO, timber and rubber wood plantations are classified as forests but fruit orchards and trees planted under agroforestry system are categorised as other lands with trees outside forests. In India, however, the legal connotation of forest is employed. An area of land recorded as forest in revenue records or proclaimed to be forest under a forest law or Act is described as forest.

2. Forest Cover

For the purpose of assessment, FSI refers 'Forest Cover' as all tree patches that have canopy density of more than 10% and area of one hectare or more in size, irrespective of land use, legal status and ownership. As the assessment is done using the remote sensing, the forest cover might also include orchards, bamboo clusters, and palms that fit into the criteria of more than 10% canopy density occupying more than 1 hectare of land. So, the term 'Forest Cover" need not necessarily be only the forests within the recorded forest area.

3. Recorded Forest Area

The 'Recorded Forest Area' or 'Forest Area' refers to all the geographical areas recorded as 'Forests' in government records irrespective of the actual trees growing on such lands. RFA mainly comprises of Reserved Forests (RF) and Protected Forests (PF) and Unclassed Forests notified under Indian Forest Act, 1927 or respective State Forest Acts. Additionally, RFA may also include all such areas, which have been recorded as 'Forest' in the revenue records or have been constituted so under any State Acts or local laws. Therefore, RFA may have blank areas with tree canopy density of less than 10% such as degraded lands, wetlands, rivers, creeks in mangroves, snow covered areas, glaciers and other snow-covered areas, alpine pastures, cold deserts, grasslands etc.

As per the definition of 'Forest cover' used in ISFR, such blank areas in RFA are excluded from the assessment of Forest cover. On the other hand, there are areas outside the RFA comprising tree patches of more than one hectare in area, with canopy density of 10% and above. Such areas include plantations on the private and community lands, road, rail, and canal side plantations, rubber, tea and coffee plantations etc. and are included in assessment of Forest cover. Thus, RFA and Forest cover overlap with each other but the two are not coterminous with each other.

4. Tree Cover

The National Forest Policy 1988 mandates that 33% of the geographical area of India should be under forest or tree cover. FSI, has been assessing forest cover since 1987 and tree cover since 2001. For this purpose, isolated trees, and small patches of trees, which are less than 1 hectare in area and found outside recorded forest areas (RFA), are considered for assessment. India is one of the few countries in the world to have a robust and scientific system of periodic forest cover assessment and inventory of Forests and Trees Outside Forest (TOF).

The forest cover mapping exercise includes all areas more than 1 hectare in extent, and having tree canopy density of 10% and more, irrespective of land use, legal status, and ownership. However, there are many small patches of trees which are less than 1 ha in extent, in village woodlots, homesteads and trees along linear features such as roads, canals, bunds, trees in urban areas and scattered trees etc. which do not get included in the forest cover due to technological limitations of satellite data used for the forest cover mapping. The extent of such small patches of the trees outside the RFA is estimated as tree cover using a methodology based on stratified random sampling, and estimated partly by using high-resolution data and partly from field inventory data.

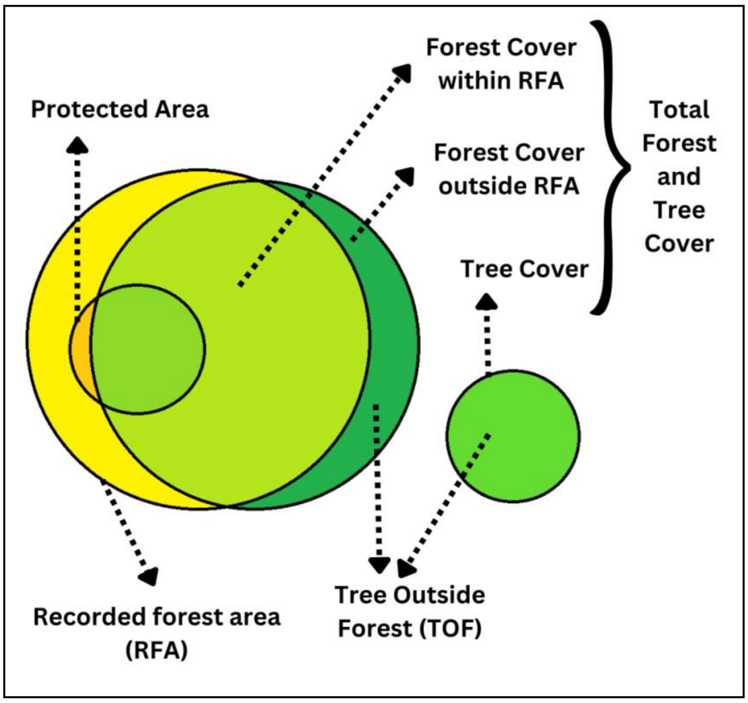
5. Trees Outside Forest (TOF)

TOF refers to all trees outside the RFA irrespective of size of the patch. Tree Cover, on the other hand, means patches of trees as well as isolated trees outside the RFA on areas less than one hectare. Hence, the trees included in Tree Cover constitute only a part of TOF and therefore, the former is a subset of the latter with the implementation of new NFI design, tree cover of the country has been estimated State-wise from the data collected during an inventory of TOF in rural and urban areas by adopting the grid-based inventory design. Separate methodologies are followed for inventory of TOF (rural) and TOF (urban).

TOF refers to all trees growing outside recorded forest areas, irrespective of the patch size. The remote sensing-based forest cover mapping includes all patches of more than one hectare within and outside the RFA. Sampling approach-based tree cover estimates include tree patches between 0.1 to 1.0 hectare outside the RFA. Tree cover outside the forests is estimated by using the sampling-based approach. Therefore, the patches of 1 ha and above outside the RFA and Tree Cover, both constitute the TOF.

During recent years, there has been a growing recognition of the importance of the Trees outside forests being a major source of forest produce in the country and timber, firewood and small wood supply coming from outside the forest areas is significant. They are one of the important renewable resources that contribute to climate change mitigation, as every patch of forest around the world is absorbing carbon. Currently, TOF is the main source of wood produced in the country, particularly from the agro forestry sector. As per an FAO Report', about 1.6 billion people or 25% of the global population worldwide depend directly or indirectly on forests for food, shelter, energy, medicines, income and from the perspective of their ecological, socio-economic, and cultural significance. (FAO (2014): The State of the world's forest genetic resources. FAO commission on genetic resources for food & agriculture, Rome)

Figure 1.1: Forest terminologies used in ISFR



1.4 PERIOD OF THE ANALYSIS

Forest Survey of India assess the forest cover mapping of the country on a two-year cycle using satellite data. The main objective is presentation of the information on forest resources of the country at state and district level and to prepare forest cover maps on 1:50,000 scale. The first assessment of forest cover of the country was made in 1987 and thereafter 16 more assessments have been made until 2021. District wise information on forest cover has been made available from the third assessment (i.e. from 1991) onwards.

Till the fourth assessment interpretation of data for the entire country had been done visually. During fifth and sixth assessment interpretation of data for Madhya Pradesh and Maharashtra which comprises 28% forest cover of the country had been done digitally and for rest of the States/UTs, it had been done visually. In seventh assessment interpretation has been done digitally for thirteen states namely; Andhra Pradesh, Arunachal Pradesh, Assam, Delhi (UT), Himachal Pradesh, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, which comprises 63% (Table 1.1) of the forest cover of the country. By eighth assessment the entire country was covered by digital assessment. However, the scale of the assessment was 1:250000 till 1999, thereafter the scale of assessment was 1:50000 until the latest 2021 report. Therefore, for the purpose of comparison and analysis the period selected is 2001 to 2021 as the scale of the assessment and the spatial resolution remains the same i.e 1:50000 scale and resolution of satellite image is 23.5m.

Table 1.1: Overview of spatial data used by FSI to generate ISFR

Cycle of Assess-ment	Year	Data Period	Sensor	Spatial Resolu-tion	scale	Minimum Mappable Unit (ha)	Mode of Inter-Preta-tion
First	1987	1981-1983	LANDSAT-MSS	80 m	1:1 million	400	Visual
Second	1989	1985-87	LANDSAT-TM	30 m	1:250,000	25	Visual
Third	1991	1987-89	LANDSAT-TM	30 m	1:250,000	25	Visual
Fourth	1993	1989-91	LANDSAT-TM	30 m	1:250,000	25	visual
Fifth	1995	1991-93	IRS-1B LISSII	36.25 m	1:250,000	25	Visual & Digital
Sixth	1997	1993-95	IRS-1B LISSII	36.25 m	1:250,000	25	Visual & Digital
Seventh	1999	1996-98	IRS-1C/1D LISS III	23.5 m	1:250,000	25	Visual & Digital
Eighth	2001	2000	IRS-1C/1D LISS III	23.5	1:50,000	1	Digital

Ninth	2003	2002	IRS-1D LISS III	23.5 m	1:50,000	1	Digital
Tenth	2005	2004	IRS-1D LISS III	23.5 m	1:50,000	1	Digital
Eleventh	2009	2006	IRS-P6-LISS III	23.5 m	1:50,000	1	Digital
twelth	2011	2008-2009	IRS-P6-LISS III	23.5 m	1:50,000	1	Digital
Thirteen	2013	2010-11	IRS-P6-LISS III IRS-Resourcesat-2 LISS III	23.5 m	1:50,000	1	Digital
Fourteen	2015	2013-14	IRS P6 LISS III IRS-Resourcesat-2 LISS-III	23.5 m	1:50,000	1	Digital
Fifteen	2017	2015-16	IRS-Resourcesat-2 LISS-III	23.5 m	1:50,000	1	Digital
Sixteen	2019	2017-18	IRS-Resourcesat-2 LISS-III	23.5 m	1:50,000	1	Digital
Seventeen	2021	2019-20	IRS-Resourcesat-2 LISS-III	23.5 m	1:50,000	1	Digital

2. OVERVIEW OF FORESTS IN TAMIL NADU

2.1 FORESTS IN TAMIL NADU

Tamil Nadu has a geographical area of 130,060 sq. kms which constitutes about 4% of the total Country's area, despite this, the State is endowed with species richness in terrestrial and coastal ecosystems. Out of 17,672 angiosperm diversity in the Country, the State of Tamil Nadu ranks first in the angiosperm diversity with about 5640 species i.e., nearly one third of the total flora of India. The State has a legacy of having about 533 endemic species, 230 red listed species, 1559 medicinal plants and the 260 species of wild relatives of cultivated plants. The Tamil Nadu also shares the Western Ghats (one of the 25 biodiversity hotspots) with the States of Kerala, Karnataka, Goa, Maharashtra, and Gujarat.

The State of Tamil Nadu in the past have taken efforts in increasing the forest density in the recorded forest area as well as the tree cover outside the recorded forest areas, which has resulted in the present forest cover of 26,419 sq.km and 4424 sq.km of tree cover. Due to the efforts taken in the past on forest and tree conservation, the State of Tamil Nadu could bring 23.70% of its geographical area under forest and tree cover. Further the forest cover of the State as per the ISFR 2021 has sequestrated 214.6 million tonnes of carbon which is 2.98% of the total carbon stock of 7203 million tonnes stored in India forest cover.

2.2 SCHEMES THAT FOCUSSED ON FOREST COVER

1. Tamil Nadu Afforestation Project (TAP)

The State of Tamil Nadu implemented the JICA funded Tamil Nadu Afforestation Project (TAP) through the Forest Department on participatory mode Joint Forest Management (JFM) from 1997-98 to 2012-13 under two phases of the Project over degraded forests over an area of 6.6 lakhs hectares and ecological restoration was undertaken with the participation of about 2317 Village Forest Councils. The State of Tamil Nadu gained varied experience in degraded forest restoration under the TAP wherein the ecological restoration was undertaken by carrying out mostly the artificial regeneration inside the degraded forest landscape by involving the local communities.

2. Tree Cultivation in Private Lands (TCPL)

Under the Tamil Nadu Biodiversity Conservation and Greening Project, the programme of TCPL was implemented since 2012-13 to 2018-19 by the Forest Department. This programme focused on fallow lands and marginal farmers. Under the said component, planting of about 8.2 crore trees of economic value covering a notional area of 1,51,600 hectares in 7,315 villages was undertaken. Farmers welcomed the programme as it provided remunerative land use for their fallow lands. Various economically important others were planted on the farm lands of about 91,000 farmers. The farmers were encouraged to plant trees on their lands and they were rewarded by way of distribution of incentives by the department in the beginning of 3rd year of planting. The tree-based assets created under TCPL were expected to improve the income of farmers considerably, besides improving the carbon sink as a climate mitigation strategy in the State.

3. Green Tamil Nadu Mission

Under the "Green Tamil Nadu Mission" which was initiated in 2021, the Government of Tamil Nadu proposes to increase the forest and tree cover in the State from present 23.7% to 33% by the year 2030-2031 as per the National Forest Policy 1988 and vision of the Government of Tamil Nadu. Growing Trees outside Forest (ToF) is an integral and vital component of the Green Tamil Nadu Mission as trees have proved to play an important role in climate change adaptation through diversified land-use practices improving the sources of income and for providing the buffering against weather related production losses, resilience building against climate impacts in farming systems etc.

Due to enhanced focus on the biodiversity conservation and management outside the forest area, the Agro-Forestry is expected to play a significant role under the Mission in order to meet out the pulp wood, plywood, matchwood, dendro-biomass, requirements for the rural & urban population, reducing the anthropogenic pressure on the natural forests leading to reversal of deforestation and forest land degradation. The farmlands and fallow lands shall be brought under the tree cover for not only achieving the 33% target but also for augmenting the farmer's income (agri-silviculture) by promoting economically viable trees on farmlands. In addition, the trees outside forest shall create additional carbon in its tree cover and augment the ever-increasing demand of the wood in the State.

2.3 TAMIL NADU IN THE PAST TWO DECADES

The table 2.1 shows that there is a tremendous increase in the population growth of the state with roughly by 10 million in each decade. For better administration, the number of districts has also increased. The table also indicates that the population has moved towards the urban area due to various reasons.

Table 2.1: Decadal Overview of Tamil Nadu

	2001	2011	2021
Geographical Area	130058 sq.km	130058 sq.km	130060 sq.km
Population	62.11 million	72.14 million	78.8 million (UID)
Average Population Density	478 person sq.km	555 person sq.km	606 person sq.km
Livestock population	25.0 Million	30.76 Million	22.72 Million
No. of Districts	16	30	32
No. of Hill Districts	4	5	5
No. of Tribal Districts	4	6	6
Urban Population	43.9%	48.40%	51.55%
Rural Population	56.1%	51.60 %	48.45%
Tribal Population	1%	1.10%	2%

The land use pattern of the state has also undergone drastic changes in the past two decade owing to the demand for more land to meet out the aspirations of the state and the people. Due to better forest management in the state, the forest area has increased by 0.38% from 2011 to 2021 (Table 2.2). There is decline in Permanent pastures & other grazing lands and Land under miscellaneous tree crops and groves which indicates that the culturable non-forest lands have decreased. A sharp increase in the fallow lands indicates the land use shifting pattern from agriculture to other purposes. Urbanisation, industrialisation, and employment opportunity in service sectors may also be the reason for the decline in the Net Area Sown.

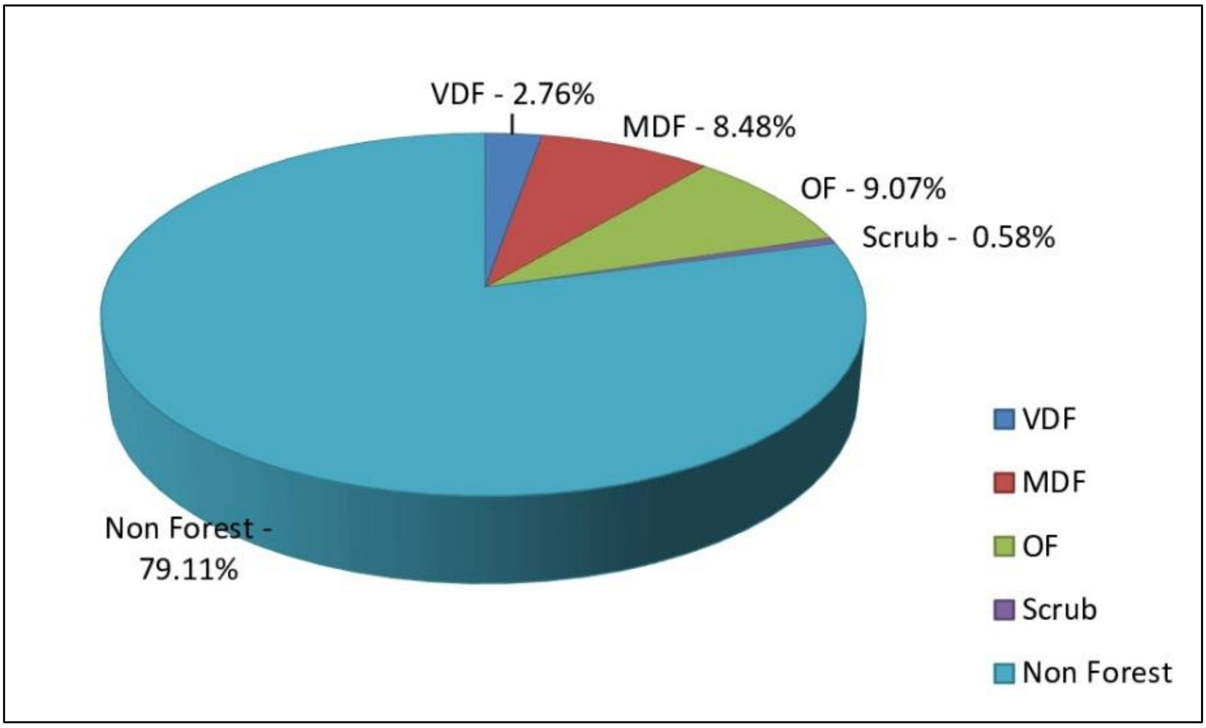
Table 2.2: Land Use classification of Tamil Nadu, Source: ISFR, FSI

	1991		2011		2021	
Land Use Types	**Area (in '000 ha)**	**%**	**Area (in '000 ha)**	**%**	**Area (in '000 ha)**	**%**
Geographical Area	13,006		13,006		13,006	
Reporting area for land utilization	12,998	100.00	13,027	100.00	13,033	100.00
Forests	2,141	16.47	2,106	16.17	2,157	16.55
Not available for land cultivation	2,418	18.60	2,665	20.46	2,659	20.40
Permanent pastures & other grazing lands	125	0.96	110	0.84	108	0.83
Land under misc. tree crops and groves	226	1.74	259	1.99	226	1.73
Culturable wasteland	345	2.65	333	2.56	320	2.46
Fallow land other than current fallows	1,229	9.46	1,498	11.50	1,932	14.82
Current fallows	1,028	7.91	1,013	7.77	992	7.61
Net area sown	5,486	42.21	5,043	38.71	4,639	35.60

2.4 STATE OF FOREST IN TAMIL NADU: ISFR 2021

- Forest Cover of the State as per 2021 assessment is 26,419 sq.km which is 20.31 % (Figure 2.1) of the Geographical Area (GA) of the State. The area under forest cover within the recorded forest area is 17,531 sq.km while the forest cover outside the recorded forest area is 8,888 sq.km.
- Area under Very Dense Forest (VDF), Moderately Dense Forest (MDF) and Open Forest (OF) is 3,593 sq.km (2.76% of GA), 11,034 sq.km (8.48% of GA) and 11,792 sq.km (9.07 % of GA) respectively.
- Total forest cover area of the State as per 2021 assessment is 26419 sq.km and the Tree cover of the State is 4424 sq.km. The forest and tree cover of the State now is 30,843.23 sq km which constitutes 23.71% of the total geographical area of the State.
- District-wise Forest cover shows districts like Erode (2,295.73 sq. km.), Coimbatore (1,985.04 sq. km), Dindigul (1,877.97 sq.km), Vellore (1,824.98 sq. km), The Nilgiris (1,731.38 sq.km) and Dharmapuri (1,702.71 sq.km) has high forest cover area.
- There is an increase of 55.21 sq.km in the forest cover of the state as compared to 2019 assessment.

Figure 2.1: Overview of forest and non-forest area in TN (ISFR 2021)



3. ANALYSIS ON THE FOREST COVER

3.1 FOREST COVER

The forest cover includes all lands which qualify the below two conditions,

1. Tree canopy density of 10% and above
2. A minimum area of one hectare.

The forest cover reported in the ISFR does not make any distinction between the origins of forest stand (whether natural or man- made) or tree species and encompasses all types of lands irrespective of their ownership, land use and legal status. Thus, all tree species and all areas including forest, private, community or institutional lands meeting the above defined criteria have been termed as forest cover.

The forest cover is assessed and monitored by interpreting the latest satellite data procured from National Remote Sensing Agency (NRSA), Hyderabad. Earlier, the forest cover assessment was made using visual interpretation technique and the scale of interpretation was 1:1 million to 1:250,000 and therefore it was not proper to make a valid comparison of results of State Forest Reports (SFR) after 2001 with those of earlier SFRs. All the earlier State Forest Reports till 2001 had divided the forests based on the canopies into two classes only – dense forest and open forest.

In 2003, there was an introduction of one more density class in the classification of forest cover. Upto SFR 2001, any forest cover with a canopy density more than 40% was classified as 'Dense Forest' (DF). There have been suggestions from many quarters that the density class from 40 to 100% was too broad and therefore, SFR 2003 shows the forest cover with a canopy density over 70% as 'Very Dense Forest' (VDF); and that with canopy density between 40 to 70% as 'Moderately Dense Forest' (MDF). The same categories have been adopted in the assessment of mangrove cover too. In this report change matrices have been developed for the districts, to do the comparison of values of the three density classes available in ISFR 2003 to 2021 – very dense, moderately dense and open forests. As ISFR 2001 has data only for two density classes, considering that for the comparison of density classes is not recommended. However, the analysis of the parameters – Forest cover, Tree Cover, Recorded Forest area and Mangrove Cover has been done with the data from ISFR 2001 to ISFR 2021 in this report.

The scale of interpretation puts a limitation (called, cartographic limit) on mapping of any geographical feature. For instance, at 1:250,000 scale, the smallest forest cover that could be delineated was 25 hectares (ha) while at 1:50,000 scale this limit comes down to 1 ha. The implication of cartographic limit was that during eighth assessment (2001), smaller patches of forest and tree canopies (1 to 25 ha in extent), could also be detected and mapped. At the same time, small blanks and gaps inside forested areas could be identified and delineated.

The National Forest Policy has mandated that 33% of the land area should be under forest/tree cover. This is however different in the different States because of the variations noticed in levels of urbanization and industrial growth. However, in the present scenario it is increasingly important that every State takes efforts to increase the green cover. Besides an increase in forest cover, encouraging tree cultivation outside forests can result in increased green cover.

Tamil Nadu has been able to record landmark achievements in increasing its green cover, by increasing the forest cover and tree cover. The State of Forest Report captures the forest cover and tree cover. The details of forest cover are provided for all the districts of the state. As per the ISFR, the total forest cover is the sum of the very dense forest, moderately dense forest, and open forest.

Tamil Nadu has a nine major forest types ranging from wet evergreen forest to moist deciduous, dry deciduous, sholas, grass lands and scrub forest. The Western Ghats are the longest hill ranges in the State and it is one of the 25 global hotspots of bio-diversity and one of the three mega centres of endemism in India. The State government has taken several measures to improve the forest cover in the degraded forest lands and they have also attempted to increase the tree cover outside the forest area through several schemes like tree cultivation in private lands (TCPL), Massive tree planting (MTP) etc.,

3.2 TREND IN THE FOREST COVER BETWEEN 2001 AND 2021

The table 3.1 shows that the overall forest cover has increased considerably from 2001 to 2021. In 2001, the total forest cover of the state was 21482 sq.km which had increased to 23625 sq.km in 2011 and further to 26419 sq.km in 2021. There has been

9.97% increase in forest cover between 2001 and 2011 and 11.82% increase in forest cover between 2011 and 2021. Overall, the forest cover has increased by 22.98% between 2001 and 2021.

This increase in the total forest cover area in the past two decades can be attributed to the efforts taken by the State Government to increase the green cover within and outside the forest area through several schemes as a measure (Figure 3.1 & 3.2).

Table 3.1: Forest Cover of Tamil Nadu since 2001 (ISFR)

Year	TN Forest Cover	TN's Forest Cover %
2001	21482	16.52
2003	22643	17.41
2005	23044	17.72
2009	23338	17.94
2011	23625	18.16
2013	23844	18.33
2015	26345	20.27
2017	26281	20.21
2019	26364	20.27
2021	26419	20.31

Figure 3.1: Notified Forests of Tamil Nadu

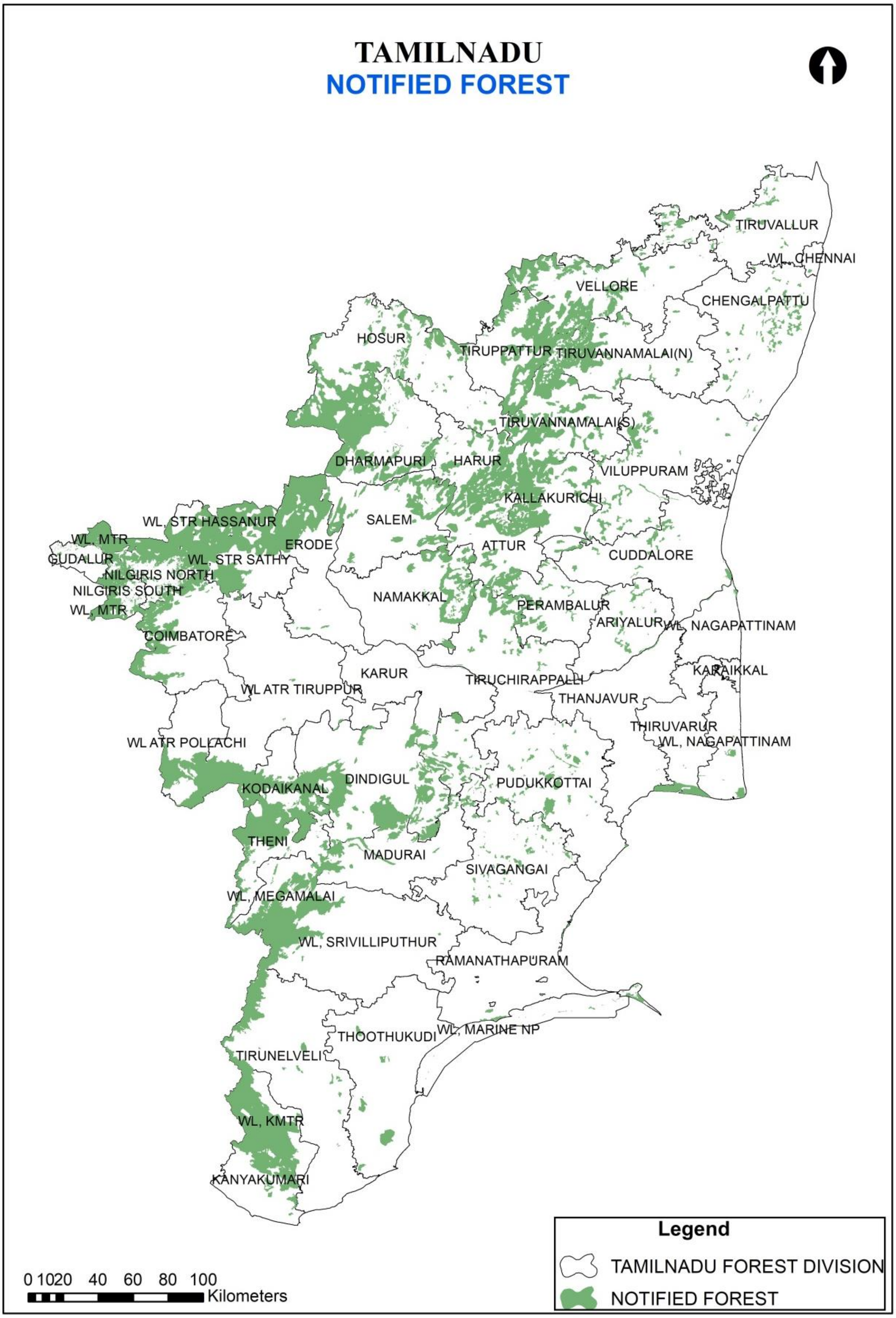
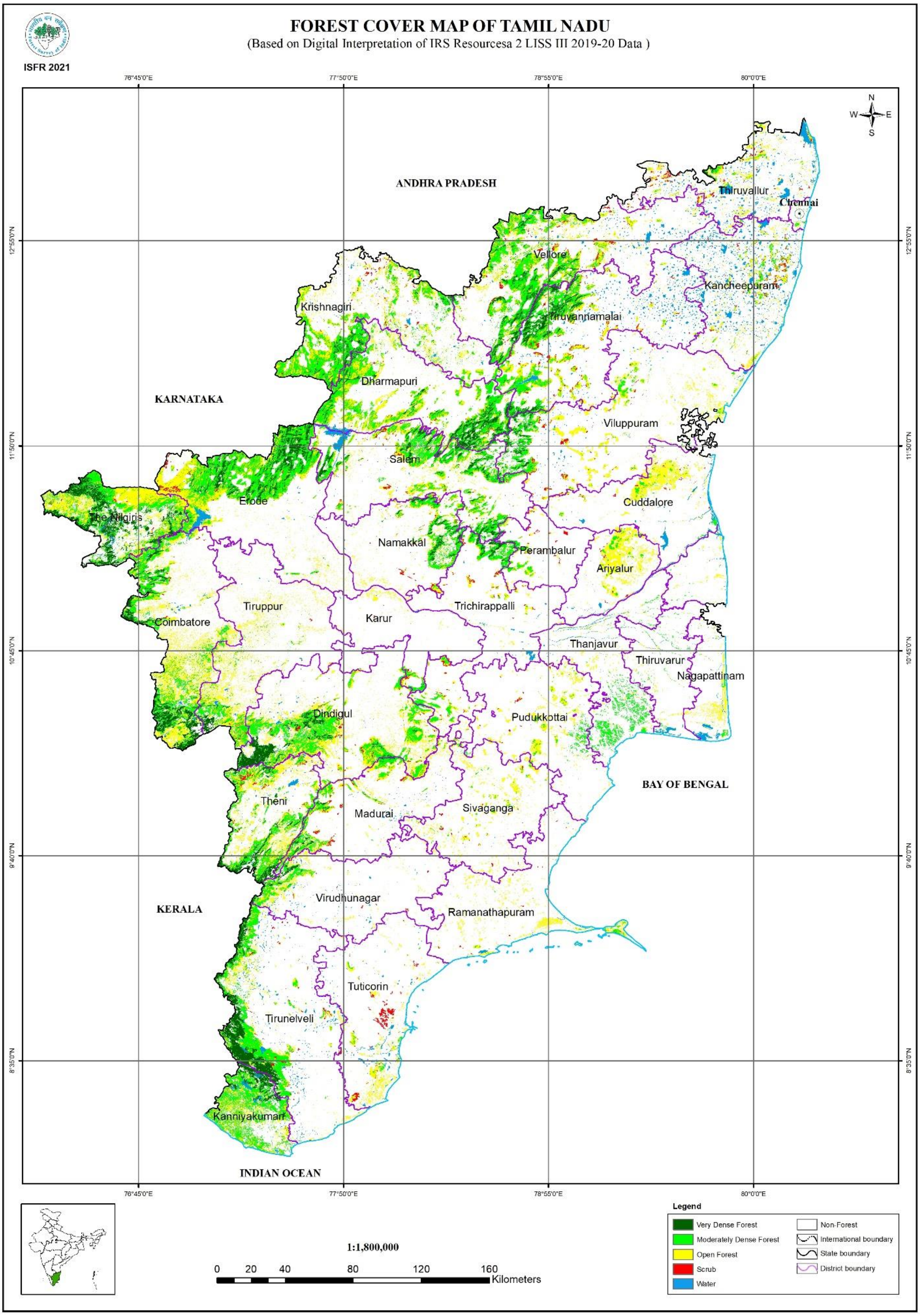


***Figure 3.2**: Forest Cover map of Tamil Nadu 2021*



3.3 INDIA'S FOREST COVER AND TAMIL NADU FOREST COVER: 2001 TO 2021

As Tamil Nadu has performed significantly in increasing its forest cover in the past two decades, this has got reflected in its contribution to the national forest cover as well. Initially in 1991, Tamil Nadu had a share of 2.77% (Table 3.2) of the country's forest cover. Tamil Nadu Forest cover percentage with the nation's forest cover during the period 2001 to 2021 is compared in this section. The table below shows there has been a significant increase in the state's share on the nation's forest cover until 2015, thereafter marginal decrease in the share was observed.

Table 3.2: Comparison of India's forest cover and Tamil Nadu's Forest cover since 2001

Year	TN Forest Cover	TN's Forest Cover %	Forest Cover	India's Forest Cover %	TN Forest Cover share on Indian Forest cover
2001	21482	16.52	675538	20.55	3.18
2003	22643	17.41	678333	20.64	3.338
2005	23044	17.72	677088	20.6	3.4
2009	23338	17.94	690899	21.02	3.378
2011	23625	18.16	692027	21.05	3.41
2013	23844	18.33	697898	21.23	3.42
2015	26345	20.27	701673	21.34	3.75
2017	26281	20.21	708273	21.54	3.71
2019	26364	20.27	712249	21.67	3.7
2021	26419	20.31	713789	21.71	3.7

The forest cover area of TN is increased by 22.98% between 2001 and 2021 whereas the national forest cover increased by 5.66% only during this period. The percentage of TN's contribution to the national forest cover has also increased substantially from 3.18% in 2001 to 3.7% in 2021.

According to FSI, the changes in the Forest Cover between two consecutive assessments reflects the actual changes on the ground during the intervening period. In addition to changes between forest to non-forest and vice versa, changes within the forests between different canopy density classes are also analysed in the next section of this report. In one of the reports, FSI states that the positive changes in the forest cover is the increase in vegetation, which can be attributed to conservation measures, afforestation activities, enhanced protection measures in plantation as well as in traditional forest areas, expansion of trees outside forest etc. Negative change corresponds to decrease in Forest Cover due to harvesting of short rotational plantations, shifting cultivation, biotic pressure, clearance in encroached areas, developmental activities etc. With respect to Tamil Nadu, the overall forest cover has increased considerably between 2001 and 2021. However, there are some remarkable observations seen within the density classes of the forest. The next section of this report covers this segment of the analysis in detail.

3.4 ANALYSIS ON FOREST COVER VARIATIONS IN THE DISTRICTS OF TN

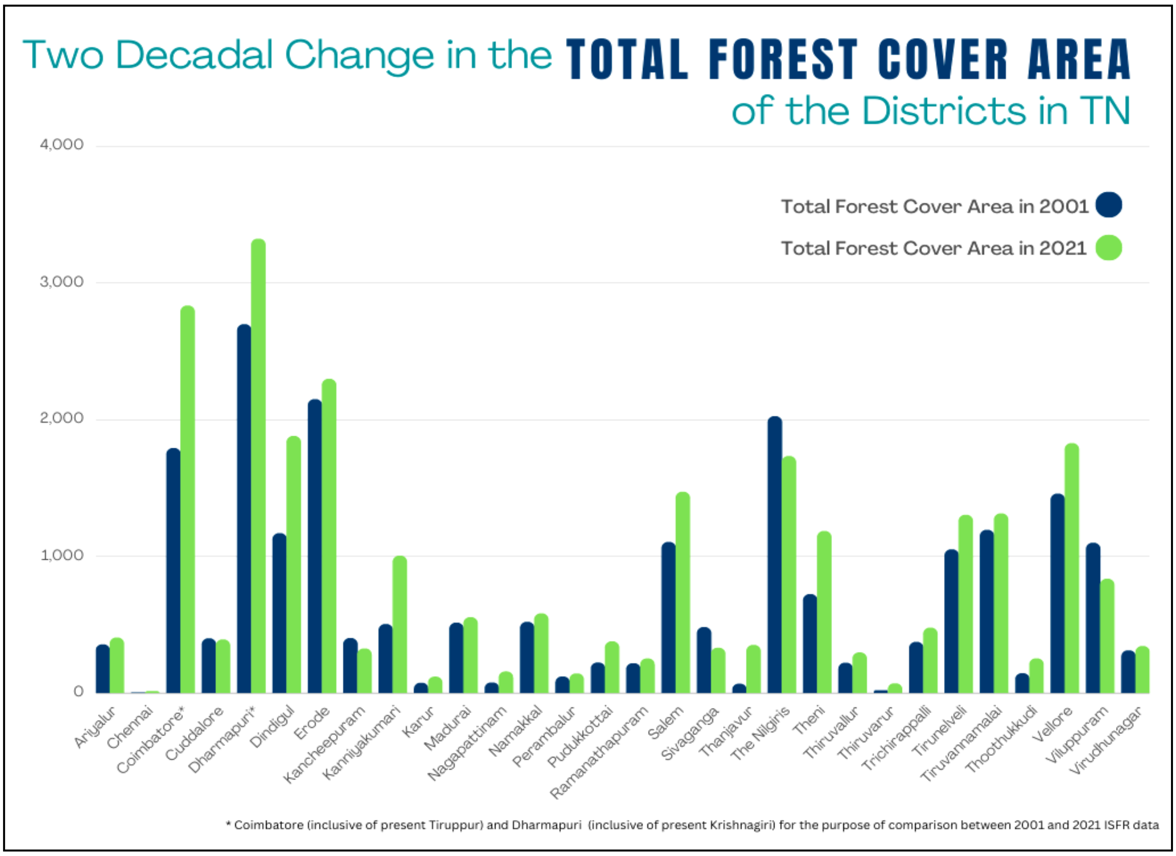
Though Tamil Nadu as a state has performed better in increasing its forest cover constantly between 2001 and 2021 (Table 8.3), the same has not been the case with all the districts in the state. The following chart compares the forest cover of the districts between 2001 and 2021. As the state had increased the number of districts in the recent years, for the purpose of comparative study the combined districts before the partition are considered. Accordingly, the comparison is done for 32 districts as listed in the table 3.3

Table 3.3: Comparison of forest cover in the districts of TN between 2001 and 2021

District	Total Forest Cover Area 2001	Total Forest Cover Area 2021	Change in the past two decades	District	Total Forest Cover Area 2001	Total Forest Cover Area 2021	Change in the past two decades
Ariyalur	354	404.6	50.6	Pudukkottai	223	377.13	154.13
Chennai	5	12.67	7.67	Ramanathapuram	217	251.49	34.49
Coimbatore	1792	1985.04	1039.23	Salem	1104	1471.12	367.12
(Tiruppur)		846.19		Sivaganga	480	331.09	-148.91
Cuddalore	398	390.24	-7.76	Thanjavur	70	350.34	280.34
Dharmapuri	2695	1702.71	625.66	The Nilgiris	2023	1731.38	-291.62
(Krishnagiri)		1617.95		Theni	724	1183.89	459.89
Dindigul	1168	1877.97	709.97	Thiruvallur	221	295.52	74.52
Erode	2147	2295.73	148.73	Thiruvarur	22	70.07	48.07
Kancheepuram	400	325.31	-74.69	Trichirappalli	374	475.82	101.82
Kanyakumari	505	1003.6	498.6	Tirunelveli	1049	1302.5	253.5
Karur	75	118.64	43.64	Tiruvannamalai	1192	1312.35	120.35
Madurai	514	553.22	39.22	Thoothukudi	145	251.97	106.97
Nagapattinam	78	156.68	78.68	Vellore	1458	1824.98	366.98
Namakkal	520	580.89	60.89	Viluppuram	1098	834.35	-263.65
Perambalur	120	142.17	22.17	Virudhunagar	311	341.62	30.62

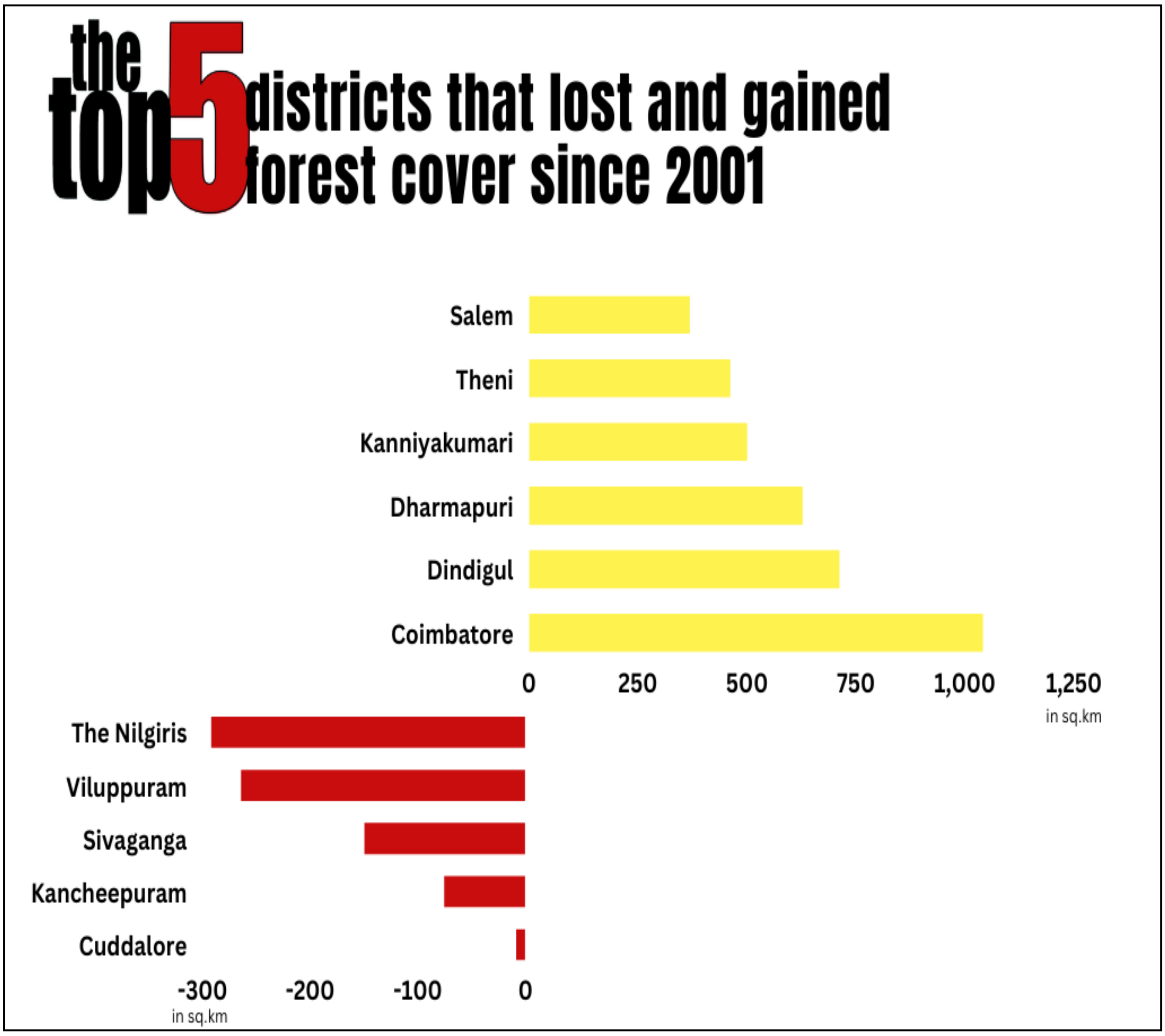
From the table 3.3 and the figure 3.3, it can be easily understood that some districts have recorded significant increase in their forest cover i.e the green cover within and outside the recorded forest area, while some have marginally increased and few have lost a handsome amount of the forest cover area. There might be several reasons for this – climatic conditions, the departmental schemes implemented during this period that involved new plantations, developmental activities in the districts and many more. The districts that have lost the forest cover during the past two decades are - Nilgiris, Villupuram, Sivagangai, Kancheepuram and Cuddalore. Similarly, the top districts that have performed better in improving their forest cover are – Coimbatore, Dindigul, Dharmapuri, Kanyakumari, Theni and Salem.

Figure 3.3 Comparison of forest cover in the districts of TN between 2001 and 2021



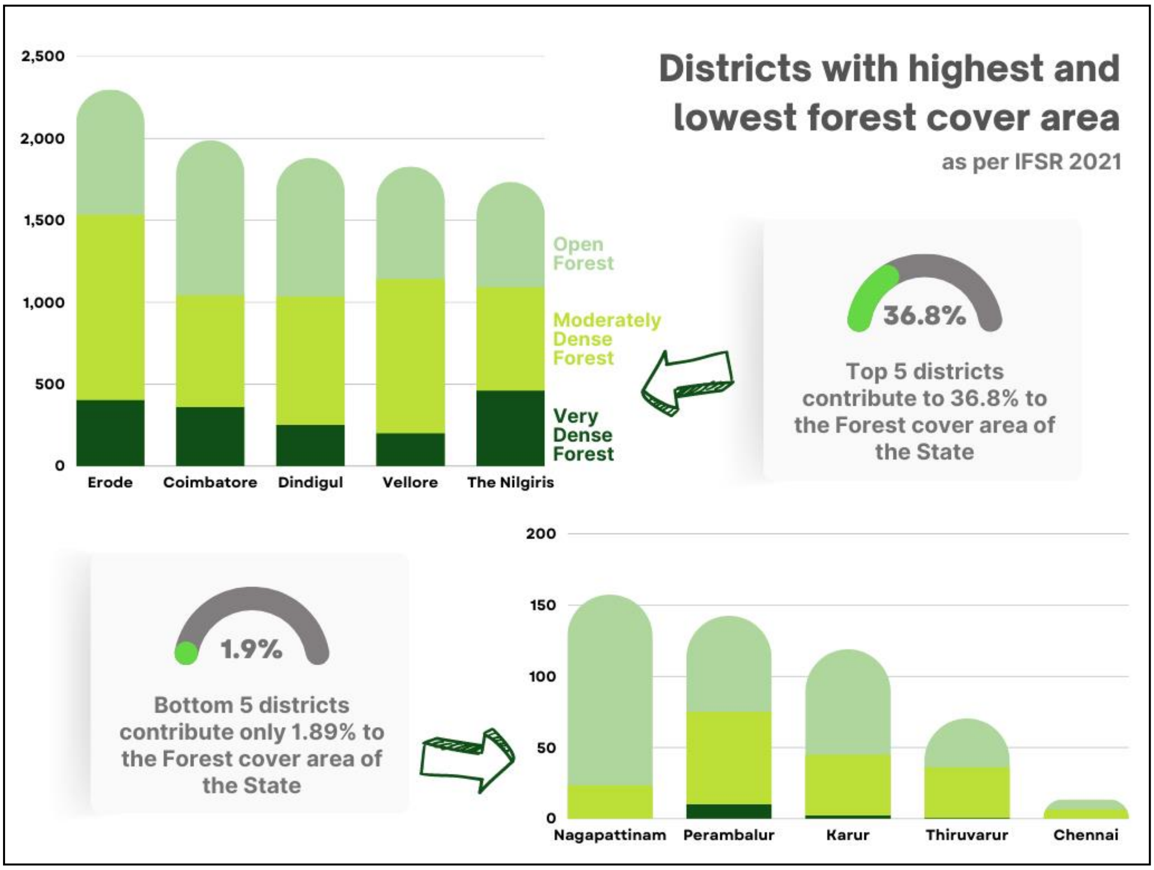
This comparative study has identified the districts that require attention in prioritizing the greening activities. The State Government can consider the five districts that have lowest forest cover and the five districts that have recorded loss in the forest cover as the 'priority districts' for the schemes like Green Tamil Nadu Mission thereby helping these districts to improve their forest cover in the upcoming years. Similarly, attention can be given to the districts that have very less forest cover. The bottom 5 districts that have lowest forest cover area as per the ISFR 2021 are – Chennai, Tiruvarur, Karur, Nagapattinam, Perambalur. These five districts contribute only 1.89% towards the state's total forest cover while the top 5 districts with high forest cover area contribute about 36.8% to the state's forest cover. These top 5 districts with high forest cover area are – Nilgiris, Coimbatore, Dharmapuri, Erode and Dindigul. In terms of percentage of geographical area with forest cover (green cover) – the top districts are – Nilgiris, Kanyakumari, Coimbatore, Theni, Erode and Dharmapuri. The districts with very low percentage of forest cover area are Tiruvarur, Karur, Thoothukudi, Nagapattinam and Ramanathapuram.

Figure 3.4 Top 5 districts that lost and gained forest cover since 2001



A deeper dive into the districts with lowest forest cover will also indicate that these districts have very less or no dense forests (Figure 3.5). Especially, Nagapattinam has no dense forest as per the IFSR 2021 data, but it had recorded 64 sq.km of dense forest during 2001. The major reason could be the cyclones during the past two decades which could have affected the density of the forest cover largely in this district. With the decrease in forest cover, there is a high possibility for the decrease in the Soil Organic Carbon (SOC) in these districts which affects the soil fertility and raises concern about possible land use conversion. In the next section, detailed analysis of the variations in the density classes of the forest has been analyzed.

Figure 3.5: Districts with highest and lowest forest cover area (ISFR 2021)



3.5 FOREST COVER WITHIN AND OUTSIDE THE RECORDED FOREST AREA

Though IFSR has provided data for different density classes of the forest cover i.e., very dense forest (>70% canopy), moderately dense forest (>40%) and open forest(>10%) for even the districts of the state, it was not possible to say that if these areas were within or outside the recorded forest area. Many conservationists have also raised concerns regarding this. To address this, FSI came up with breakup details of the forest cover (VDF, MDF and OF) within and outside the recorded forest area from 2015 onwards. The data on the Forest cover within and outside the recorded forest area of Tamil Nadu is provided below from 2015 to 2021 (Table 3.4)

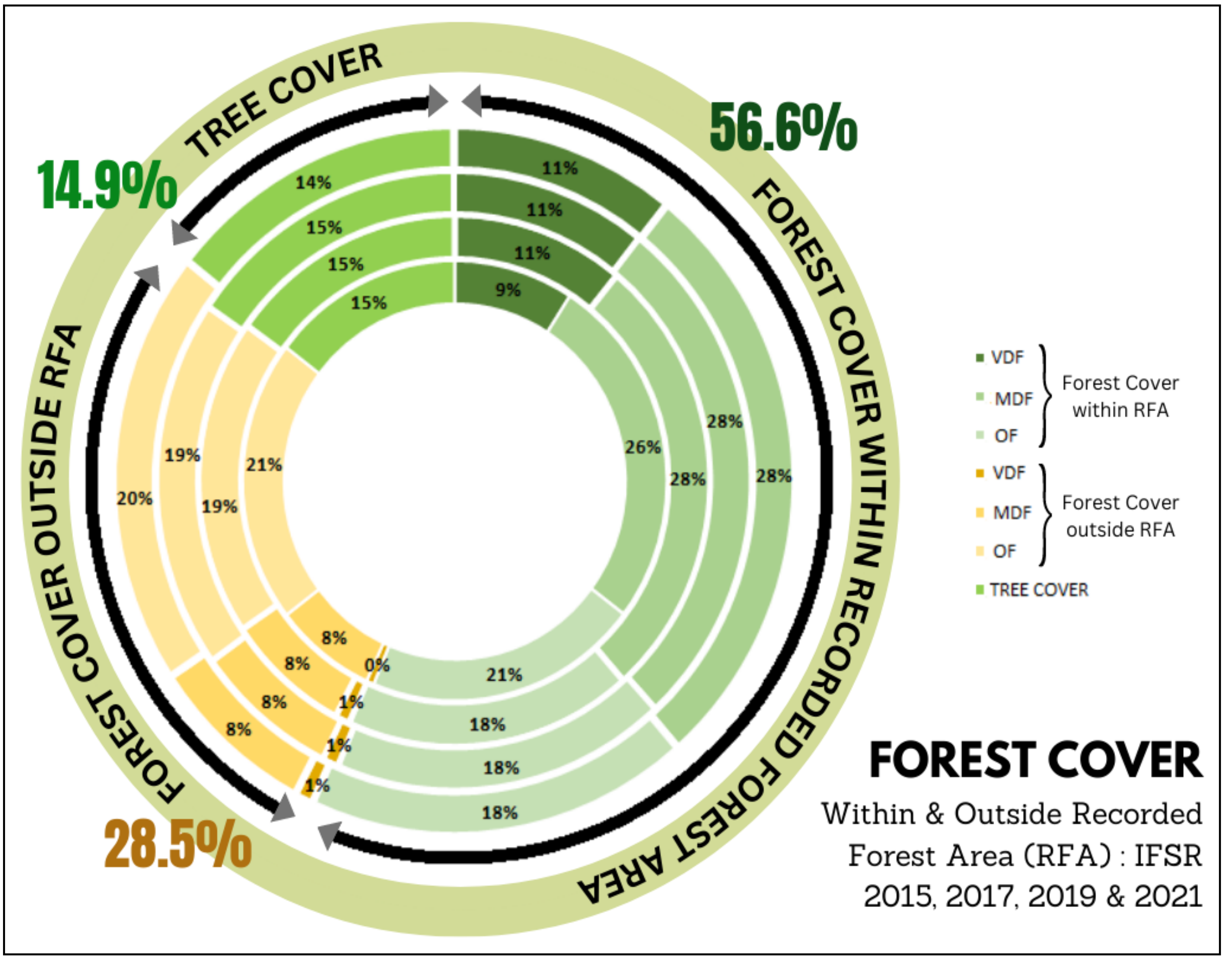
This data indicates that on an average, the recorded forest area has contributed about 56.58% to the total green cover (forest cover + tree cover) of the state while the areas outside the forest (with a canopy density of more than 10% and a min of 1 hectare of area) has contributed 28.5% and the small patches of trees less than 1 ha of land have contributed 14.88% towards the state’s green cover respectively (Figure 3.6). This inference indicates that apart from improving the forest cover within the recorded forest area, the

state government can also focus more on developing the extend of the horticulture and agro-forestry models in the private and public lands, as the latter would not only have its share on improving the state's green cover percentage, but will also help to supplement the farmers income and will also act as a climate mitigation measure.

Table 3.4: Forest cover within and outside recorded forest area in TN

ISFR	Forest cover within RFA (in sq.km)				Forest Cover outside RFA (in sq.km)				Total Forest Cover Area (in sq.km)	Tree Cover (in sq.km)	Total forest & tree cover (in sq.km)
	VDF	MDF	OF	Total	VDF	MDF	OF	Total			
2015	2814	8069	6482	17365	179	2400	6401	8980	26345	4505	30850
2017	3386	8544	5651	17581	286	2435	5979	8700	26281	4671	30952
2019	3330	8578	5681	17589	275	2452	6048	8775	26364	4830	31194
2021	3320	8580	5631	17531	273	2454	6161	8888	26419	4424	30843

Figure 3.6: Overview of Forest cover within and outside recorded forest area in TN



4. VARIATIONS IN THE DENSITY CLASSES OF FOREST COVER

4.1 FOREST COVER & DENSITY CLASSES

The whole of geographical area of the country has been classified into two broad categories of land cover, i.e., "Forest Cover" and "Non- Forest". The forest cover is further classified in the following 4 classes based on the canopy density - very dense forest, moderately dense forest, open forest and scrub (Figure 4.1)

Very dense Forest (VDF)	All Lands with tree cover (Including mangrove cover) of canopy density of 70% and above
Moderately Dense Forest (MDF)	All lands with tree cover (Including mangrove cover) of canopy density between 40% and 70% above
Open forest (OF)	All lands with tree cover (Including mangrove cover) of canopy density between 10% and 40%
Scrub	All forest lands with poor tree growth mainly of small or stunted trees having canopy density less than 10 percent
Non-Forest	Any area not included in the above classes

Till 2001, the earlier eight State of Forest Reports, classified forest cover into two broad categories only: Dense Forest and Open Forest. Dense Forest included all lands with a forest cover of trees with a canopy density over 40% while Open Forest showed all lands with a forest cover of trees with a canopy density between 10 and 40 percent. As many raised concerns over the broad range for the class "Dense Forest" which itself had encompassed a large range of crop density that could not have the capacity to detect the significant changes in canopy density within this class. A new class was introduced in 2003 to address this issue.

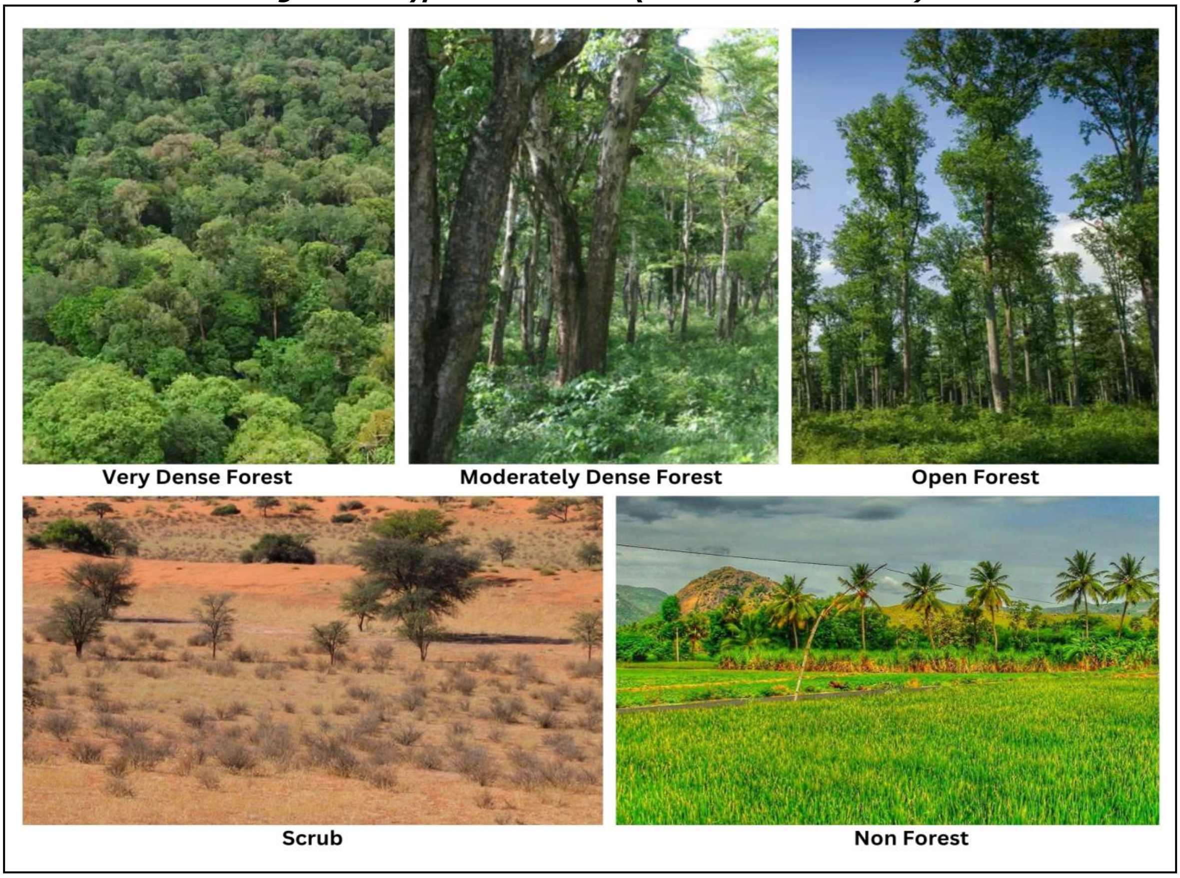
From 2003, the category of "Dense Forest" was sub-divided into two classes: "Very Dense Forest" (where canopy density is above 70 percent) and "Moderately Dense Forest" (where canopy density lies between 40 and 70 percent). This made it possible to monitor changes in forest quality more closely.

Highly degraded forest or wastelands with stumped trees having canopy density less than 10% were classified as scrubs, a category of non-forest cover. Mangrove cover is also delineated separately in the ISFR report due to their unique signature along the coastal areas. Mangroves were further classified into three density classes of forest cover as described above. After delineation, mangrove cover also gets added up with forest cover in the respective density classes.

For the purpose of the calculation of the Forest cover in the IFSR, FSI has considered only the three classes – VDF, MDF and OF. Scrub denotes lands having bushes and/or poor tree growth with canopy density less than 10 percent. Such lands are delineated largely within or around continuous forest areas. The scrub land is considered as non-forest in the estimation of the forest cover. But the purpose of assessing the scrub land is that there is high possibility that the scrub land gets converted as open forest with any planned intervention that improves its canopy density to a value above 10%

The category "non-forest" includes all lands without forest cover, such as agricultural croplands, grasslands, wastelands, scrub, water bodies, riverbeds, snow covered mountains, rocks and built-up areas.

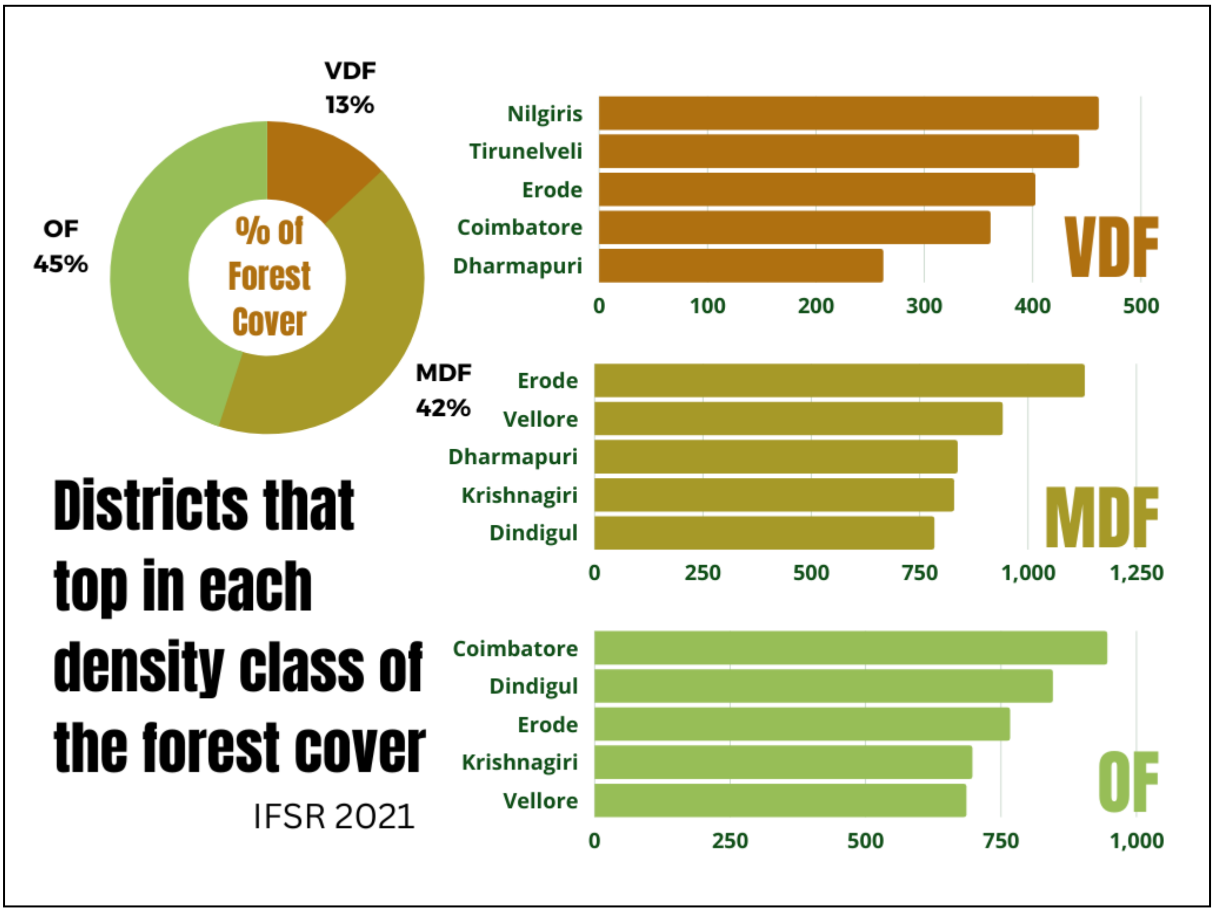
Figure 4.1: Types of land cover (Forest and Non-Forest)



4.2 ASSESSMENT OF THE FOREST DENSITY CLASSES IN TAMIL NADU

The IFSR 2021 has details of the three classes of the forest cover and the scrub for 32 districts. The share of three density classes on the forest cover signifies the extend of the very dense, moderately dense and open forests area in the state: VDF - 13%, MDF – 42% and OF-45 % (IFSR 2021). The districts with high extend of very dense forest, moderately dense forest and open forest are ranked in the following figure 4.2.

Figure 4.2 Districts ranked according to forest cover classes



(x axis in sq.km)

4.3 VARIATIONS IN THE DENSITY CLASSES SINCE 2003

For the purpose of comparison of the three variables i.e VDF, MDF and OF over the past two decades, we consider the data of IFSR 2003, IFSR 2011 and IFSR 2021 (IFSR 2001 – had only two density classes – Dense Forest and Open Forest, and it was from IFSR 2003, FSI came up with three density classes – VDF, MDF and OF)

Table 4.1: Forest Cover Area of Tamil Nadu from 2003 – 2021 (unit in sq.km)

2003 to 2011							
	VDF	**MDF**	**OF**	**TFCA**	**% of VDF**	**% of MDF**	**% of OF**
2003	2440	9567	10636	**22643**	10.78%	42.25%	46.97%
2005	2650	9790	10604	**23044**	11.50%	42.48%	46.02%
2009	2926	10216	10196	**23338**	12.54%	43.77%	43.69%
2011	2948	10321	10356	**23625**	12.48%	43.69%	43.83%
Average	**2741**	**9973.5**	**10448**	**23162.5**			
% of TFCA	**11.83%**	**43.06%**	**45.11%**				

2011-2021							
	VDF	**MDF**	**OF**	**TFCA**	**% of VDF**	**% of MDF**	**% of OF**
2011	2948	10321	10356	23625	12.48%	43.69%	43.83%
2013	2948	10199	10697	23844	12.36%	42.77%	44.86%
2015	2993	10469	12883	26345	11.36%	39.74%	48.90%
2017	3672	10979	11630	26281	13.97%	41.78%	44.25%
2019	3605.49	11029.55	11728.98	26364.02	13.68%	41.84%	44.49%
2021	3593.01	11034.03	11792.19	26419.23	13.60%	41.77%	44.63%
Average	**3293.25**	**10671.93**	**11514.53**	**25479.71**			
% of TFCA	**12.92%**	**41.88%**	**45.19%**				

On analyzing the data with respect to the three density classes between 2003 and 2021, the state has shown an increase in all of these three density classes in terms of area which has contributed to the overall increase in Total Forest Cover Area (TFCA) of the state (Table 4.1).

Considering the percentage share of each of these density classes over the TFCA, the following inferences are made,

1. The average value of VDF class was 2741 sq.km during the first decade (2003-2011) which increased to the 3293.25 sq.km in the second decade (2011-2021). Despite all this, it can be seen in the above table that post 2017, the share of the Very dense forests has been decreasing. Since 2017, the state has lost 78.99 sq.km of very dense forest class. This raises serious concern and requires thorough study to identify the reasons and the areas where there was a loss.
2. Moderately dense forests have also shown an increasing trend with an absolute increase about 1467 sq.kmduring the period 2003 to 2021.

3. Open Forests has shown a decreasing trend in the first decade (2003 to 2011) and then it started to increase until 2015. Further the open forest area continued to decrease. Despite these fluctuations there has been an increase in the net area of the open forest by 1156 sq.km between 2003 and 2021.
4. Analyzing the share in terms of the percentage, the VDF has increased from 10.78% to 13.60%, MDF has reduced from 42.25% to 41.77%, open forest has reduced from 46.97% to 44.63% - which indicates that the state as a whole has been progressing well in improving the quality of the forest

Overall, all the three density classes of the forest cover have shown increase in the area between 2003 and 2021. But it is more important to analyze the variations of each of these classes in the districts in order to understand and identify the districts whose forest have been vulnerable to the external threats during this period. This exercise will help the State Government to take possible measures to help those districts to address the issues that challenges the quality of the forest. For this purpose, the change matrix was computed with the data of the all the three density classes from the IFSR 2003, 2011 and 2021 for the 32 districts. Next section has that discussion in detail.

4.4 VERY DENSE FOREST

1. There was no significant loss in the very dense forest class in most of the districts that have this type of forests. This indicates that the protection and the conservation strategy of the State Government (Tamil Nadu Forest department and the other departments) have been so effective in preserving this class of forest. Very dense forest within the recorded forest area are those areas which are rich in biodiversity and they have a unique ecosystem that renders many ecosystem services.
2. In the past decade five districts have recorded loss in very dense forest category – they are Dindigul (-99 sq.km), Erode (-65.83 sq kms), Tiruchirapalli (-20.47 sq.km), Theni (-15.83 sq.km) and Perambalur (-8.97 sq.km). The loss of dense forest area between 2003-2011 has been 226 sq.km with Nilgiris recording a loss of about 164 sq.km followed by Kanyakumari (-38 sq.km), Coimbatore (-24 sq.km) and Virudhunagar (-25 sq.km) (Table 4.2). The loss of very dense forest category has been almost in the same range i.e about 210 sq.km during the decade 2011-2021. On comparing the net loss between 2003 to 2021, Tiruchirapalli and Virudhunagar have lost dense forest to an extent of 15 sq.km. Special focus shall be given to all these districts to recover the lost dense forest category and to improve the extend of the very dense forest.

Table 4.2: Very Dense Forest Area of districts in Tamil Nadu

VERY DENSE FOREST (VDF)						
District	**DF reported in 2003**	**VDF reported in 2011**	**VDF reported in 2021**	**Change from 2003 to 2011**	**Change from 2011 to 2021**	**Change from 2003 to 2021**
Ariyalur	0	0	0	0	0	0
Chennai	0	0	0	0	0	0
Coimbatore (including Tiruppur)	405	381	409.08	-24	28.08	4.08
Cuddalore	0	0	0	0	0	0
Dharampuri (including Krishnagiri)	193	241	356.72	48	115.72	163.72
Dindigul	63	351	251.99	288	-99.01	188.99
Erode	378	468	402.17	90	-65.83	24.17
Kancheepuram	0	0	0	0	0	0
Kanyakumari	78	40	136.08	-38	96.08	58.08
Karur	0	0	2.24	0	2.24	2.24
Madurai	31	23	38.87	-8	15.87	7.87
Nagapattinam	0	0	0	0	0	0
Namakkal	40	55	83.41	15	28.41	43.41
Perambalur	9	19	10.03	10	-8.97	1.03
Pudukkottai	0	0	0.77	0	0.77	0.77
Ramanathapuram	0	0	0	0	0	0
Salem	67	139	197.62	72	58.62	130.62
Sivaganga	0	0	0	0	0	0
Thanjavur	0	0	0	0	0	0
The Nilgiri	404	240	460.67	-164	220.67	56.67
Theni	89	199	183.17	110	-15.83	94.17
Thiruvallur	0	0	11	0	11	11
Thiruvarur	0	0	0.46	0	0.46	0.46
Tiruchirapalli	69	74	53.53	5	-20.47	-15.47
Tirunelveli	203	278	442.48	75	164.48	239.48
Tiruvanamalai	165	169	233.64	4	64.64	68.64
Toothukudi	0	0	0	0	0	0
Vellore	165	172	200.98	7	28.98	35.98
Villuppuram	27	70	79.36	43	9.36	52.36
Virudhunagar	54	29	38.74	-25	9.74	-15.26

4.5 MODERATELY DENSE FOREST

The change matrix developed with the data of the MDF has given significant observations which are summed up below.

1. The extend of the loss in the MDF area and the number of districts that have recorded this loss has been more in the second decade i.e (2011 to 2021) than the first decade (2003 to 2011). This indicates that the decade 2011-2021 had many challenges that has made these forests vulnerable to undergo the loss. There is also a possibility that the effect of the developmental activities, climatic conditions like drought and cyclones, harvesting of the rotational trees or change in the land use patterns which could have been the reasons for this loss in almost 50% of the districts. At the same time, other districts have significantly increased the extend of the MDF area to the extent that there is only a net gain in the total MDF area which has increased from 9567 sq.km (2003) to 11934 sq.km (2021) (Table 4.3).

2. Considering the change between 2021 and 2011, Nilgiris had a loss of about 348 sq kms in MDF area followed by Erode, Tirunelveli, Cuddalore & Villupuram with 242, 193, 170 & 70 sq kms of area lost respectively.

3. Four districts have recorded loss in two successive decades i.e change in area between 2011 & 2003 and 2021 & 2011 – those 4 districts are – Ramanathapuram, Sivagangai, Thiruvallur and Villupuram. These four districts have to be closely monitored in terms of their green cover in the years to come and suitable measures should be taken to stop this trend of losing the forest cover and to compensate the loss in the previous two decades. A separate study can be carried out to identify what was the actual reason for this loss in the MDF category of the forest cover in these districts.

4. One other analysis was done with the MDF data, the change of MDF during the period 2003 to 2021 was compared with the respective year’s change in the Total Forest cover area during the same period. It was found out that the loss in the MDF area of 5 districts coincides with the loss in total forest cover of the respective districts during the same period which indicates that these districts should also be closely monitored. The five districts in which this observation was made are – Cuddalore, Kancheepuram, Sivagangai, Nilgiris and Villupuram.

Table 4.3: Moderately Dense Forest Area of districts in Tamil Nadu

MODERATELY DENSE FOREST (MDF)									
District	MDF in 2003	MDF in 2011	MDF in 2021	Change in MDF 2003 to 2011	Change in MDF 2011 to 2021	Change in MDF 2003 to 2021	Forest Cover in 2003	Forest Cover in 2021	Change in Forest cover (2003-2021)
Ariyalur	28	65	40.38	37	-24.62	12.38	283	404.6	121.6
Chennai	3	6	6.17	3	0.17	3.17	6	12.67	6.67
Coimbatore (including Tiruppur)	833	922	917.64	89	-4.36	84.64	1804	2831.23	1027.23
Cuddalore	185	218	47.56	33	-170.44	-137.44	433	390.24	-42.76
Dharmapuri (including Krishnagiri)	1051	1078	1663.36	27	585.36	612.36	2954	3320.66	366.66
Dindigul	662	551	782.12	-111	231.12	120.12	1266	1877.97	611.97
Erode	1174	1371	1128.56	197	-242.44	-45.44	2230	2295.73	65.73
Kancheepuram	106	123	71.79	17	-51.21	-34.21	377	325.31	-51.69
Kanyakumari	253	417	570.22	164	153.22	317.22	535	1003.6	468.6
Karur	13	27	42.58	14	15.58	29.58	88	118.64	30.64
Madurai	197	293	232.76	96	-60.24	35.76	531	553.22	22.22
Nagapattinam	16	43	23.48	27	-19.52	7.48	53	156.68	103.68
Namakkal	294	189	283.97	-105	94.97	-10.03	551	580.89	29.89
Perambalur	54	35	64.81	-19	29.81	10.81	130	142.17	12.17
Pudukkottai	81	78	106.51	-3	28.51	25.51	238	377.13	139.13
Ramanathapuram	101	80	23.84	-21	-56.16	-77.16	235	251.49	16.49
Salem	528	422	757.2	-106	335.2	229.2	1134	1471.12	337.12
Sivagangai	169	86	37.6	-83	-48.4	-131.4	478	331.09	-146.91
Thanjavur	60	133	265.02	73	132.02	205.02	129	350.34	221.34
The Nilgiris	878	978	629.51	100	-348.49	-248.49	2071	1731.38	-339.62
Theni	405	491	471.06	86	-19.94	66.06	831	1183.89	352.89
Thiruvallur	62	59	46.1	-3	-12.9	-15.9	222	295.52	73.52
Thiruvarur	10	23	35.65	13	12.65	25.65	26	70.07	44.07
Tiruchirapalli	153	145	228.35	-8	83.35	75.35	394	475.82	81.82
Tirunelveli	549	760	566.56	211	-193.44	17.56	1099	1302.5	203.5
Tiruvannamalai	478	523	596.61	45	73.61	118.61	1315	1312.35	-2.65
Thoothukudi	46	25	25.72	-21	0.72	-20.28	152	251.97	99.97
Vellore	608	628	939.55	20	311.55	331.55	1693	1824.98	131.98
Villupuram	431	370	299.05	-61	-70.95	-131.95	1056	834.35	-221.65
Virudhunagar	139	182	130.3	43	-51.7	-8.7	329	341.62	12.62

4.6 OPEN FOREST

The following are the inferences from the change matrix developed with the data of the Open Forest (OF) in the districts of Tamil Nadu,

1. The extend of the loss in the Open Forest area has been more in the second decade i.e (2011 to 2021) than in the previous decade (2003 to 2011). This indicates that the decade 2011-2021 had many threatening conditions for the existence of the forests. There is also a possibility that the effect of the developmental activities, climatic conditions like drought and cyclones, harvesting of the rotational trees or change in the land use patterns could have been the reasons for this loss in almost 50% of the districts. At the same time, other districts have significantly increased the Open Forest area to an extent that there is only a net gain in the total open forest area which has increased from 10636 sq.km (2003) to 11792 sq.km (2021) (Table 4.4).

2. The change matrix points out to 6 districts that have lost more than 50 sq. km of the open forest area during the period 2003 and 2021 – Dharmapuri (409 sq.km), Vellore (235 sq.km), Tiruvannamalai (190 sq km), Nilgiris (147.8 sq km), Villupuram (142 sq km) and Tirunelveli (53.54 sq. km)

3. The change in the OF area during the period 2003 to 2021 was compared with the change in the Total Forest cover area during the same period. It was found that the loss of open forest area of five districts coincides and has contributed to the loss in the total forest area of that respective district during the same period – such districts are Nilgiris, Villupuram, Kancheepuram, Sivagangai and Tiruvannamalai. This indicates that the lost open forest area has not moved to the moderately dense forest class but has moved out of the open forest class, thus resulted in the loss of the total forest cover area.

4. Among all other districts – Nilgiris and Villupuram have lost a large extend of open forest area that has led to the loss in the district's total forest cover area too. A detailed study to identify the factors that has led to this loss has to initiated immediately.

Table 4.4: Open Forest Area of districts in Tamil Nadu

OPEN FOREST (OF)									
District	2003	2011	2021	Change in of 2003 to 2011	Change in of 2011 to 2021	Change in of 2003 to 2021	Forest Cover in 2003	Forest Cover in 2021	Change in Forest cover (2003-2021)
Ariyalur	255	253	364.22	-2	111.22	109.22	283	404.6	121.6
Chennai	3	3	6.5	0	3.5	3.5	6	12.67	6.67
Coimbatore (including Tiruppur)	566	527	1504.51	-39	977.51	938.51	1804	2831.23	1027.23
Cuddalore	248	222	342.68	-26	120.68	94.68	433	390.24	-42.76
Dharmapuri (including Krishnagiri)	1710	1715	1300.58	5	-414.42	-409.42	2954	3320.66	366.66
Dindigul	541	587	843.86	46	256.86	302.86	1266	1877.97	611.97
Erode	678	366	765	-312	399	87	2230	2295.73	65.73
Kancheepuram	271	253	253.52	-18	0.52	-17.48	377	325.31	-51.69
Kanyakumari	204	195	297.3	-9	102.3	93.3	535	1003.6	468.6
Karur	75	61	73.82	-14	12.82	-1.18	88	118.64	30.64
Madurai	303	271	281.59	-32	10.59	-21.41	531	553.22	22.22
Nagapattinam	37	99	133.2	62	34.2	96.2	53	156.68	103.68
Namakkal	217	300	213.51	83	-86.49	-3.49	551	580.89	29.89
Perambalur	67	86	67.33	19	-18.67	0.33	130	142.17	12.17
Pudukkottai	157	177	269.85	20	92.85	112.85	238	377.13	139.13
Ramanathapuram	134	205	227.65	71	22.65	93.65	235	251.49	16.49
Salem	539	669	516.3	130	-152.7	-22.7	1134	1471.12	337.12
Sivaganga	309	231	293.49	-78	62.49	-15.51	478	331.09	-146.91
Thanjavur	69	62	85.32	-7	23.32	16.32	129	350.34	221.34
The Nilgiris	789	868	641.2	79	-226.8	-147.8	2071	1731.38	-339.62
Theni	337	271	529.66	-66	258.66	192.66	831	1183.89	352.89
Thiruvallur	160	155	238.42	-5	83.42	78.42	222	295.52	73.52
Thiruvarur	16	7	33.96	-9	26.96	17.96	26	70.07	44.07
Tiruchirapalli	172	188	193.94	16	5.94	21.94	394	475.82	81.82
Tirunelveli	347	179	293.46	-168	114.46	-53.54	1099	1302.5	203.5
Tiruvannamalai	672	695	482.1	23	-212.9	-189.9	1315	1312.35	-2.65
Thoothukudi	106	134	226.25	28	92.25	120.25	152	251.97	99.97
Vellore	920	939	684.45	19	-254.55	-235.55	1693	1824.98	131.98
Villupuram	598	569	455.94	-29	-113.06	-142.06	1056	834.35	-221.65
Virudhunagar	136	69	172.58	-67	103.58	36.58	329	341.62	12.62

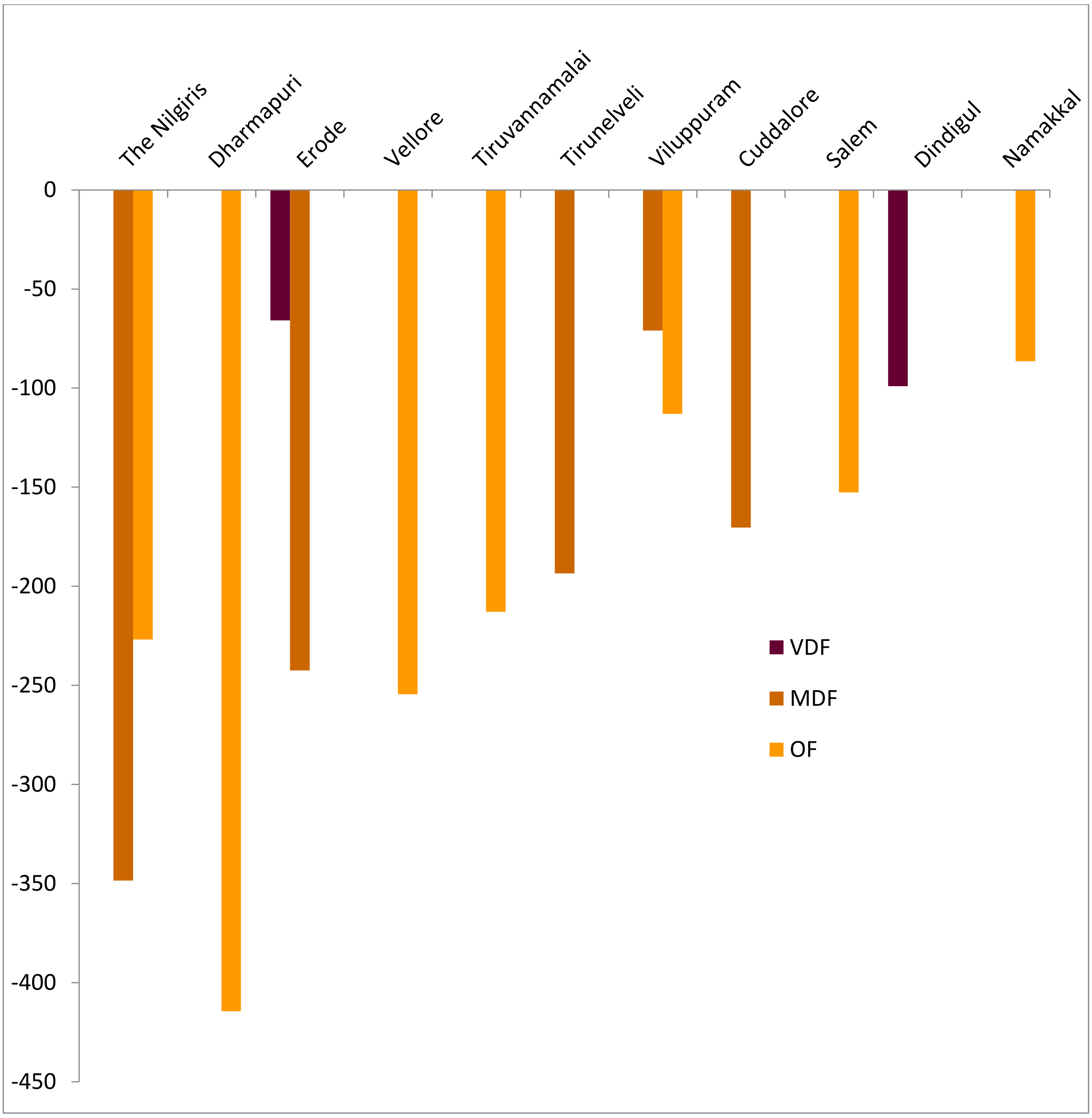
4.7 DISTRICTS THAT LOST FOREST COVER IN THE PAST DECADE

The change matrix has identified few districts that have recorded considerable loss in the forest cover areas (Table 4.5). Though there was a loss in a particular density class of the following districts over the past decade, it is compensated by a gain in the other density classes in some districts, thus the change in total forest cover area of that respective district did go negative. But the loss in the dense forest and moderately dense forest category is of great concern as it is an indicator of the quality of the forest in that particular district. The following districts can be considered as "priority districts" to improve the growing stock, to increase its green cover and also to conserve the existing forest cover areas. The top districts that have lost a considerable amount of forest cover between 2011 and 2021 are ranked in the figure 4.3.

Table 4.5: Districts that Lost Forest Cover

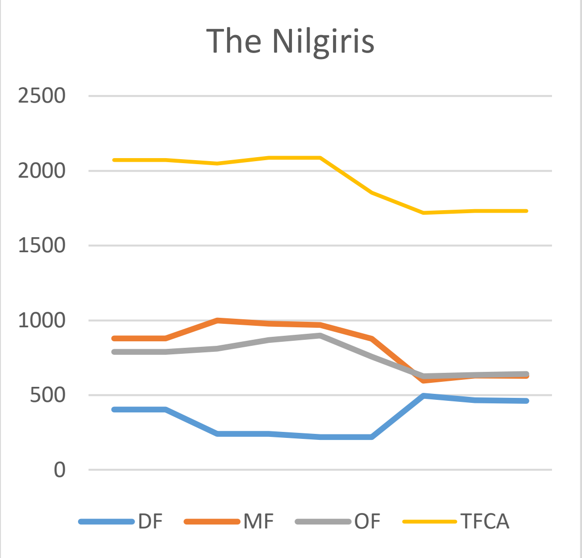
Districts	VDF	MDF	OF	Total Loss
Nilgiris		-348.49	-226.8	-575.29
Dharmapuri			-414.42	-414.42
Erode	-65.8	-242.44		-308.24
Vellore			-254.55	-254.55
Tiruvannamalai			-212.9	-212.9
Tirunelveli		-193.44		-193.44
Villupuram		-70.95	-113.06	-184.01
Cuddalore		-170.44		-170.44
Salem			-152.7	-152.7
Dindigul	-99.01			-99.01
Namakkal			-86.49	-86.49
Madurai		-60.24		-60.24
Ramanathapuram		-56.16		-56.16
Virudhunagar		-51.7		-51.7
Kancheepuram		-51.21		-51.21
Sivaganga		-48.4		-48.4
Theni	-15.83	-19.94		-35.77
Perambalur	-8.97		-18.67	-27.64
Ariyalur		-24.62		-24.62
Trichirappalli	-20.47			-20.47
Nagapattinam		-19.52		-19.52
Thiruvallur		-12.9		-12.9
Coimbatore		-4.36		-4.36

Figure 4.3: Top Districts That Lost Forest Cover



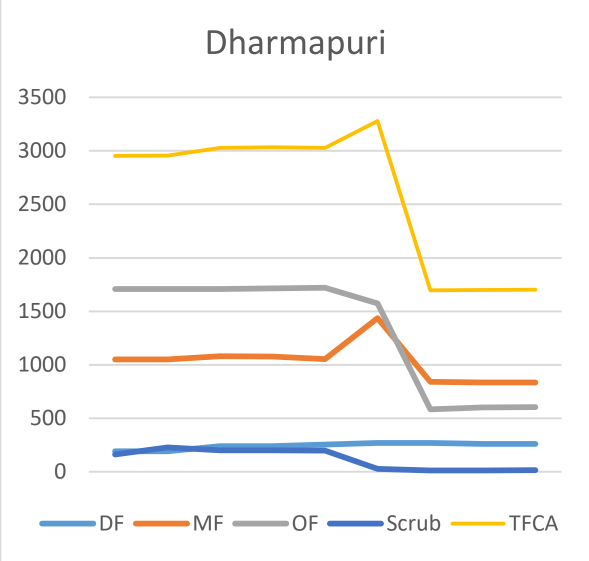
Though these districts have lost area in one or more density classes, there is a possibility the lost area had added on the already existing area of the other density classes. In order to get the correct status of forest in a district, the trend analysis comparing the area lost and gained by all the three density classes that contributes to the total forest cover area of the district has to be done. In Table 4.6 the major findings of trend analysis of the forest cover parameters is done for the top 9 districts listed out in Table 4.5. (For detailed results of the trend analysis refer chapter 8)

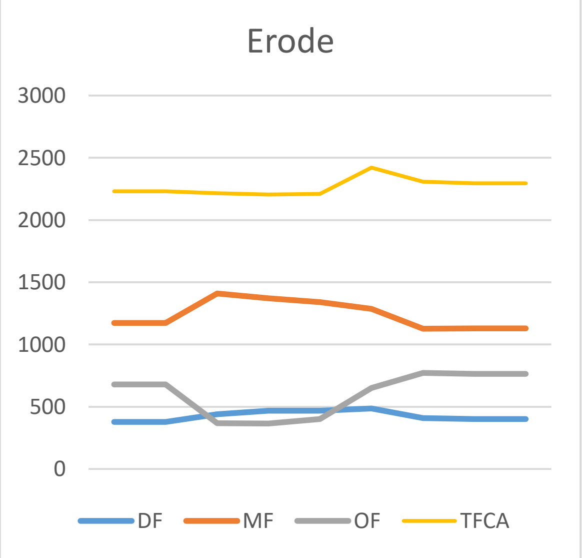
Table 4.6 Trend analysis of selected districts that had lost area in any one of the density classes



Between 2003 and 2021, Nilgiris has lost its total Forest cover of about 339 sq. km. There has been a reducing trend in the moderately dense forest and in the open forest as well. Though the very dense forest showed an increasing trend until 2015, at present it has a decreasing trend. Therefore, this district should be monitored closely for its green cover.

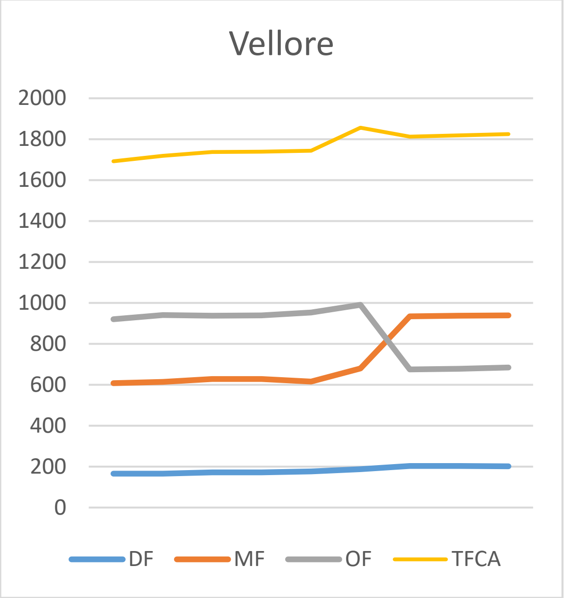
Between 2003 and 2021, Dharmapuri has lost its total Forest cover of about 1251 sqkm but the reason for this is largely due to the bifurcation of the district into two. (Krishnagiri has recorded 1618 sq.km of forest cover in 2021). Even when considering the combined values of both these districts for the purpose of analysis, Dharmapuri has lost a considerable amount of Moderately dense and open forest during the decade 2011- 2021. Therefore, close monitoring of the forest cover is required in this district as this district is a rich habitat for wildlife.

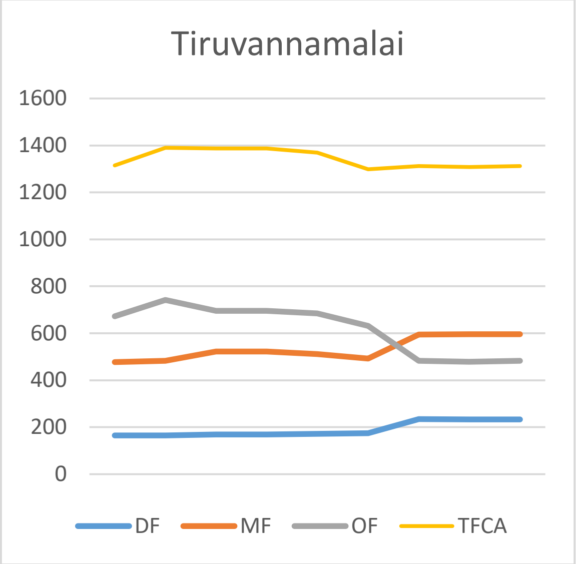




Erode has shown a decreasing trend in the forest cover during the decade 2011-21. The very dense forest and the moderately dense forest have also recorded a loss of about 308 sq.km. This district is a part of Western ghats and Satyamangalam tiger reserve located here supports wildlife like tigers and elephants. Therefore, close monitoring of the forest cover in this district is required.

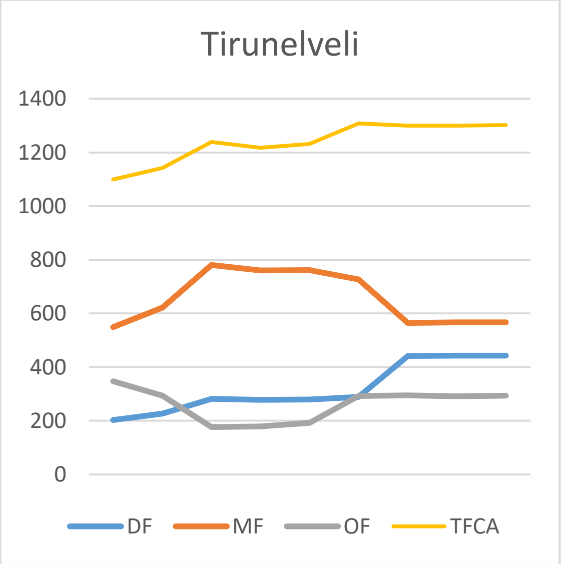
There has been a decreasing trend in the total forest cover of Vellore during the decade 2011-2021 which is largely due to the loss of larger portion of its open forest area of about 254 sq.km. A part of this district is in the range of the Eastern ghats covered with good forest. Losing open forest area may be due to the increasing urbanisation and outcome of climate change. Deeper analysis is required and measures should be taken to improve the canopy density in the scrub lands and in culturable non forest lands.

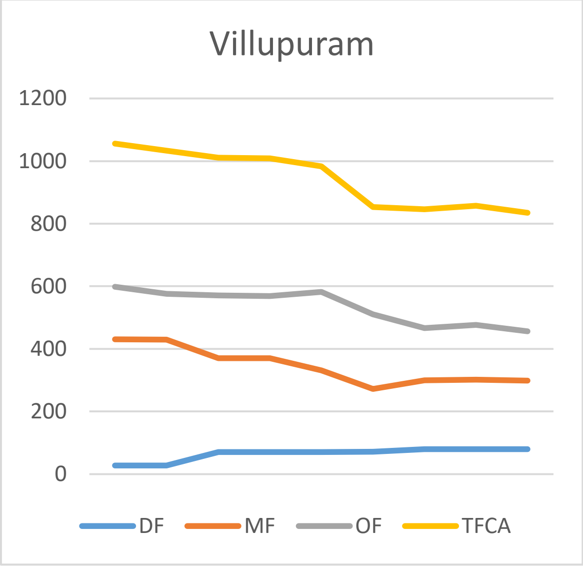




During the period 2007 to 2015, the district has shown reduction in the total forest cover area which is because of the fall in open forest area. Though VDF and MDF has shown an increasing trend in this district, the open forest has been decreasing in the past two decades. There was a loss of 212.9 sq. km in open forest area. So, the district should take up suitable measures to protect the existing open forest and to add more area in this category.

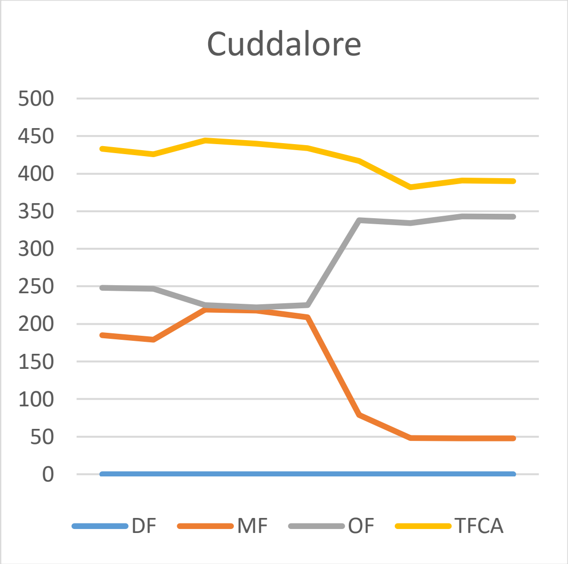
Tirunelveli has shown increasing trend in the Total Forest cover area in the past two decades. VDF and Open Forest also have an increasing trend. But the district has been losing its Moderately dense forest which rings the alarm bell. Losing a good portion of the moderately dense forest is not a good indicator, as these areas could have possibly moved to open forest or scrub. So deeper analysis is required in this regard.

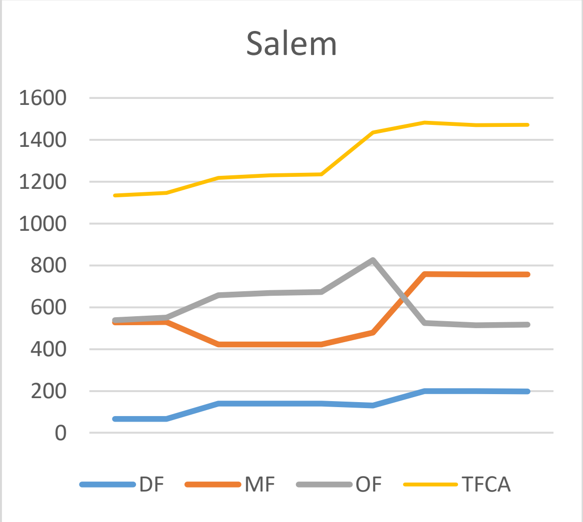




Villupuram is one other district to be on the prime focus. The district has been losing its forest cover area since 2001. The district covers the Eastern ghats range of Kalrayan hills which has been subjected to several challenges due to the increasing urbanisation and encroachments. Moderately dense forest and open forest areas are steadily decreasing in this district. Deeper analysis followed by corrective measures should be taken up immediately to address the issue.

Cuddalore has also been performing poor in terms of the forest cover. There has been a decreasing trend in the forest cover since 2005. The main reason for this a steep fall in the moderately dense forest category. This district is known for short rotation agro forestry plantations. The sharp fall in the MDF, might be due to change in the land use pattern. So deeper analysis is required for Cuddalore and measures should be taken to address this issue.





Though the total forest cover area is on increase from 2001, Salem has lost about 152 sq.km of Open forests in the past two decades. Measures should be taken to find out the reason for this and to address it.

5. ANALYSIS ON THE RECORDED FOREST AREA

In India, a piece of land is recognized as forest if it is legally proclaimed to be forest area under a forest law (e.g., Indian Forest Act of 1927) and it is recorded/notified as forest in government records. The primary responsibility of managing, protecting and conserving forests within recorded forest areas lies with the corresponding State Forest Departments.

The recorded forest area is further classified into three categories:

1. Reserved Forest - Reserved Forest is an area notified under the provisions of Indian Forest Act or the State Forest Acts and it receives the highest degree of protection. All activities are prohibited unless permitted within a Reserved Forest.
2. Protected Forest - Protected Forest is also notified under the provisions of Indian Forest Act or the State Forest Acts but it has only a limited degree of protection. In Protected Forests all activities are permitted unless prohibited.
3. Unclassed Forest - Unclassed Forest is an area recorded as forest but not included in reserved or protected forest category. Ownership status of such forests varies from forest to forest and state to state.

5.1 RECORDED FOREST AREA IN TAMIL NADU

Tamil Nadu has its own State Forest act that is Tamil Nadu Forest Act 1882 which classifies forest as – Reserved Forest (section 16 notified forests under the TNFA1882), Reserve Land includes all land notified under section 4 of the Tamil Nadu Forest Act, 1882 (Tamil Nadu Act V of 1882) and any area specially declared by the Collector to be Reserved land.

Tamil Nadu also has an act named 'Tamil Nadu Preservation of Private Forests Act (TNPPF Act)-1949' and some districts have private forests which are also included in the calculation of the recorded forest area. There are also "protected areas" in Tamil Nadu which includes National parks, Wildlife sanctuaries including bird sanctuaries, tiger reserves, elephant reserves and conservation reserves. FSI also provides with the details of the recorded forest area in the ISFR. The recorded forest area of Tamil Nadu as per the ISFR since 2001 is listed in the table 5.1.

Table 5.1: Recorded Forest area in Tamil Nadu

ISFR	Recorded Forest Area (sq.km)	Reserved Forest Area	Protected Forest	Others	% of RFA to geographical area of TN
2001	22871	19325	2240	1306	17.59
2003	22877	19388	2183	1306	17.59
2005	22877	19388	2183	1306	17.59
2009	22877	19388	2183	1306	17.59
2011	22877	19388	2183	1306	17.59
2013	22877	20293	1782	802	17.59
2015	22877	20293	1782	802	17.59
2017	22877	20293	1782	802	17.59
2019	22877	20293	1782	802	17.59
2021	23188	20523	1053	1612	17.83

In Tamil Nadu, the increase in the recorded forest area is possible only when there is a notification of new reserved forests or transfer of leased land to the department, Compensatory afforestation land is proposed to be declared as reserved land, Land notified U/S 26 of TNFA 1882 and pending preparation of section 4 proposal, Section 4 proposal recommended by District Collector or when land is acquired for departmental purpose.

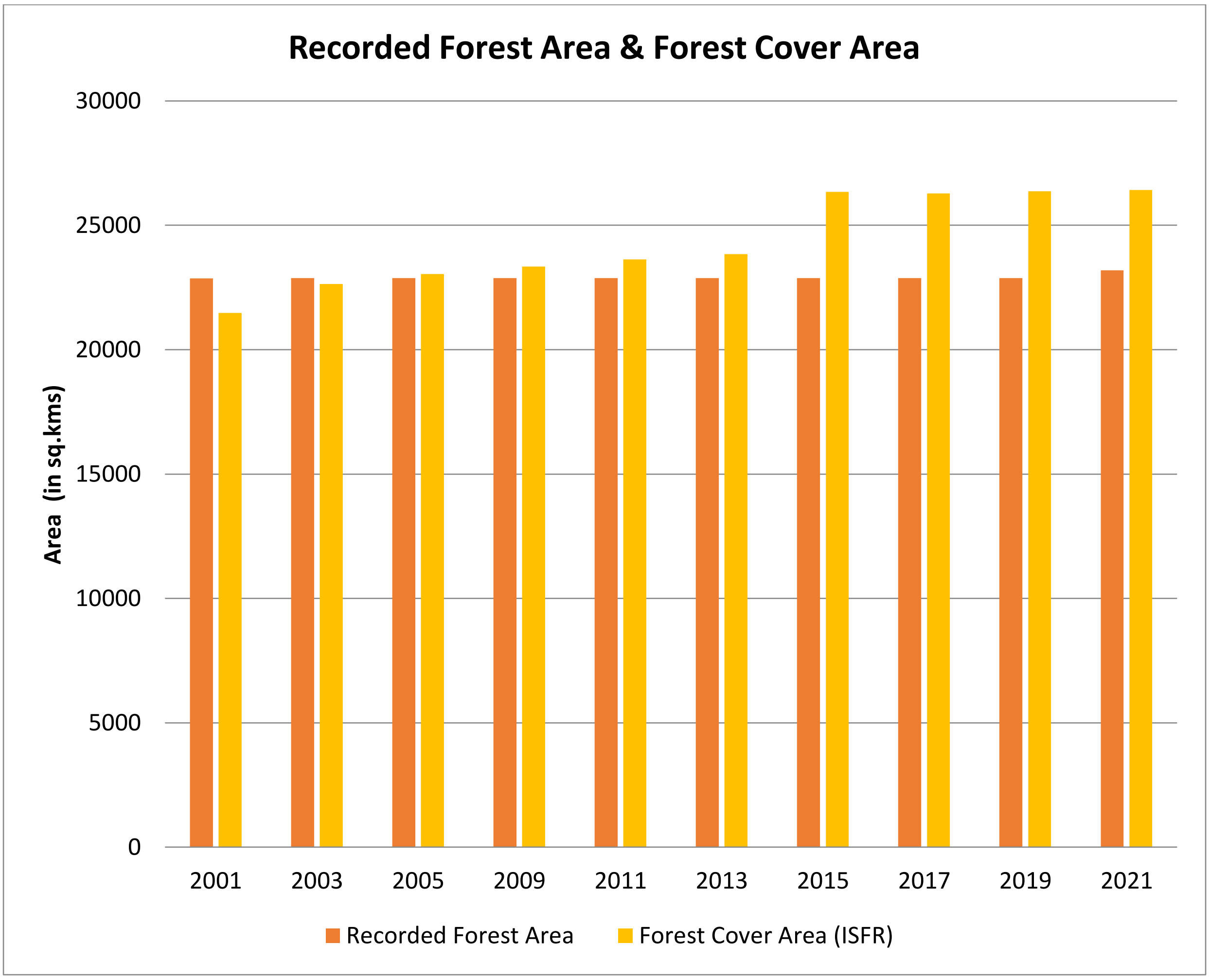
5.2 RECORDED FOREST AREA AND FOREST COVER AREA

Table 5.2: Recorded Forest area and forest cover area in Tamil Nadu

ISFR	Recorded Forest Area	% of RFA to TN area	Forest Cover Area (ISFR)	% of Forest cover area to TN area
2001	22871	17.59	21482	16.52
2003	22877	17.59	22643	17.41
2005	22877	17.59	23044	17.72
2009	22877	17.59	23338	17.94
2011	22877	17.59	23625	18.16
2013	22877	17.59	23844	18.33
2015	22877	17.59	26345	20.27
2017	22877	17.59	26281	20.21
2019	22877	17.59	26364	20.27
2021	23188	17.83	26419	20.31

The percentage of recorded forest area to the geographical area of Tamil Nadu increased by only 0.24% (table 5.2 & figure 5.1), whereas the forest cover area in TN increased by 3.79% in the past two decades. The following graph indicates that the forest cover area has a sharper rise even beyond the recorded forest area. This indicates that the area outside the recorded forest area have also contributed largely to the forest cover of the state. Until 2015, ISFR did not provide details about the forest cover within and outside the recorded forest area. In the earlier chapter "Analysis of Forest Cover", detailed analysis of the forest cover within and outside the recorded forest area was done in section 3.5. The recorded forest area has contributed about 56.58% to the total green cover (forest cover + tree cover) of the state while the areas outside the forest (with a canopy density of more than 10% and a min of 1 hectare of area) has contributed 28.5% and the small patches of trees less than 1 ha of land have contributed 14.88% towards the state forest cover respectively.

Figure 5.1: Recorded Forest area and forest cover area in Tamil Nadu



5.3 INCREASING TREND IN FOREST COVER

There has been a significant increase in the forest cover area in Tamil Nadu and also in other states. One of the important reasons behind this is the plantation works carried out by Forest Department and other departments within and outside the forest. The objective of establishing forest plantations is to enhance the forest cover so that the national goal of 33% forest and tree cover can be achieved. The additional benefits of the plantation are to produce sufficient quantity of wood and related products to meet the needs of society and wood-based industries. Though the forestry plantations constituted an important component of the five-year development plans in the country since the beginning; large-scale plantations to the tune of more than a million ha per year started since 1979. The decade of 1980-90 has been the boom period for forestry plantations due to the launch of social forestry projects in several States. It was generally felt that these plantations will add to the forest cover to increase its extent in proportionate manner. It is, however, to be noted that not all plantations will have 100% survival rate which depends on the climatic conditions, water availability, rainfall, biotic pressure etc. Some plantations are raised in degraded forests to improve the stocking, which would not result in a net increase of forest cover but will only improve the quality of the forest stock.

During last decade of the 20th century, Tamil Nadu had a special scheme called as "*Tamil Nadu Afforestation Project*". Tamil Nadu Afforestation Project (TAP) aimed at ecological restoration and biological upgradation of degraded forests and other lands abutting 1368 villages in Tamil Nadu. It was launched from 1997-98 to 2004-05 and funded by Japan Bank for International Co-operation (JBIC), Japan. It was implemented on watershed basis with the style of 'Joint Forest Management', wherein people's participation in planning, execution, benefit sharing, monitoring and evaluation was ensured. Afforestation works were carried out at a large scale of 480179 hectares in the Phase 1 of the project. During the Phase II of the TAP scheme, afforestation was carried out in about 208550 hectares during the period 2005 to 2013.

The *National Afforestation Programme* (NAP) is one other scheme which was launched during 2002-03 and was implemented by the Tamil Nadu Forest Department with 100% central assistance. The objectives of this scheme were also to increase and / or improve forest and tree cover and to rehabilitate degraded forest lands.

Additionally, the state came up with another scheme to encourage tree cultivation outside forests, '*Tree cultivation in Private Lands*' was implemented during 2012-13 to 2018-19, which is first of its kind in the country. It was implemented by carrying out block planting and inter-crop planting in the private lands outside the forest. Plantation of about 161110 hectares was carried out through this scheme.

In order to make tree planting a massive people-oriented exercise as well as to increase green cover in the State, *Massive Tree Planting* programme was implemented from 2011 to 2020. Annually about 60 to 70 lakhs trees were planted during this period by involving people, institutions and industries.

The State Government has launched a major greening project with an aim to bring 33% of the total geographical area under forest and tree cover in the next 10 years. Further, taking tree planting on a massive scale and on a mission mode, the State Government announced "*Green Tamil Nadu Mission*" in 2021. It aims in increasing the state's tree and forest cover from 23.7% to 33% by 2031 by taking up planting in 1.35 million hectares with a target of 260 crore seedlings. An estimate shows that 25 to 30 crore saplings must be planted every year and ensure there is at least 60-65 % survival rate to achieve the target. The tree plantation will be undertaken outside the forest area. The area to be identified includes schools, institutions, highways, parks, and other public spaces. To accomplish the mission, the Chief Minister of Tamil Nadu has called for a synergy between all the departments of the State.

As a result of these schemes that involved tree planting at large scale both within and outside the forest, the green cover of the state has been steadily increasing at a good rate. The rate at which the total forest cover area increased during 2001 to 2021 was more than the rate at which the recorded forest area increased during the same period. As the total forest cover area in Tamil Nadu is more than the recorded forest area, measures and initiatives must be taken up immediately to increase the forest cover within the recorded forest area. This is crucial because such measures will improve the quality of the forest and the growing stock within the recorded forest area which act as habitat for the wild animals. Availability of adequate fodder and water resources within the forest area will reduce the animal straying outside the forest, thus resulting in less human – wildlife conflict.

6. ANALYSIS ON THE TREE COVER OF THE STATE

The normal perception is that forest cover would include areas covered by the canopy of naturally occurring forests, while manmade tree crops and plantations should constitute tree cover. When interpreting satellite imagery for a small area followed by intensive ground verification, it may be possible to distinguish natural forests from plantations. As forest cover estimation is made using satellite images, the definition of the Tree cover is not as per the general understanding.

With respect to ISFR, Tree cover means the area covered by crown of trees that is too small to be delineated by digital interpretation of remote sensing data at 1:50,000 scale used for forest cover assessment. India’s National Forest Policy aims at maintaining 33 % of country’s geographical area under forest and tree cover. FSI has been assessing country’s forest cover since 1980’s using data from remote sensing satellites on a two-year cycle, but tree cover due to a substantial number of trees not captured by the satellite data was estimated and reported as tree cover for the first time only in 2001 assessment. During the 2001 assessment, the cover on account of all other trees in the country that could not be captured by the satellite data was also estimated. These trees comprise of tree groves and woodlots smaller than 1 ha in area or narrow strips of tree plantations along linear features (e.g., roads, canals, bunds, etc.) or scattered trees on farms, homesteads and urban areas. These were estimated using field inventory methods. Thus, for the first time a complete assessment of forest and tree cover of the country was made during the eighth assessment and reported in SFR 2001. It provided new baseline information on forest and tree cover in the country. Only trees having diameter of 10 cm or more at breast height were included in this assessment.

A statistically sound stratification and sampling design was developed for assessing tree cover at the national level. The country was stratified into zones constituting such geographic areas that exhibit broad similarity in the factors responsible for tree growth (e.g., altitude, geographic location, soil, precipitation, temperature, soil moisture, etc.) and thus support fairly homogenous tree vegetation. These zones were termed as physiographic zones and the country was stratified into fourteen zones. The data obtained from inventory of trees in sampled rural and urban units was processed and aggregated to estimate number of trees of different diameter classes and species for all physiographic zones. Later, a new methodology based on remote sensing to estimate the tree cover below 1 ha was developed using LISS III data. In the new methodology, high resolution PAN data has been used along with LISS III data to stratify the districts into three strata, viz. block plantation, linear plantation and scattered trees. By this method it was possible to identify a tree vegetated land as small as 0.1 ha on the ground. Ground inventory was carried out to generate adequate data.

6.1 TREE OUTSIDE FOREST AND TREE COVER

It is important here not to confuse between Tree Cover and "Tree Outside Forest" (TOF). TOF means all tree crops outside recorded forest area. However, there are tree crops and woodlots outside forest area that are larger than 1 ha in extent and can be captured by the satellite data used for forest cover assessment. Such tree canopies are deemed to have been included in the forest cover assessment. The crown cover of residual trees outside forest area constitutes tree cover. Thus, trees included in tree cover constitute only a part of TOF. Recognizing the fact that TOF contributes significantly to socio-economic and ecological status of a country, Food and Agriculture Organization of United Nations has given prominent place to TOF in its Global Forest Resources Assessment Report. FSI has been conducting inventory of TOF since 1991. Data for estimating tree cover has been extracted from the data of TOF collected by FSI. TOF may lie within rural areas or urban areas and has correspondingly been termed as TOF (Rural) and TOF (Urban). The country was stratified into different zones for assessment of TOF and tree cover. TOF (Rural) and TOF (Urban) are estimated separately using different techniques.

Tree cover complements forest cover and should not be analyzed in isolation. Data on the total number of trees or the area under tree cover alone does not convey much useful information that can be used for policy and planning purposes. A region with lower forest cover is likely to have higher number of trees in Culturable Non-Forest Area (CNFA). If a forest area or tree plantation becomes highly degraded and its canopy density falls below 10 percent, it will be a loss to forest cover but may contribute to tree cover. Therefore, it must be noted here that the extent of tree cover assessed here is an appendage to forest cover. However, certain statistics that are of interest are average number of trees per ha within CNFA of a zone or a state.

A high number would imply effective steps taken for tree planting by the Government, Municipalities, Farmers and people in general. Another statistic that can be derived is the number of trees per ha of tree cover. A low number means that the trees (included in tree cover) are generally large in size and age, while a high number would indicate that such trees in that region are generally young and small sized. This report focuses on analyzing the trend in the tree cover area and its contribution to the state's green cover.

6.2 TREE & FOREST COVER IN TAMIL NADU

The Table 6.1 summarizes the tree cover and forest cover of Tamil Nadu from the ISFR 2001 to 2021.

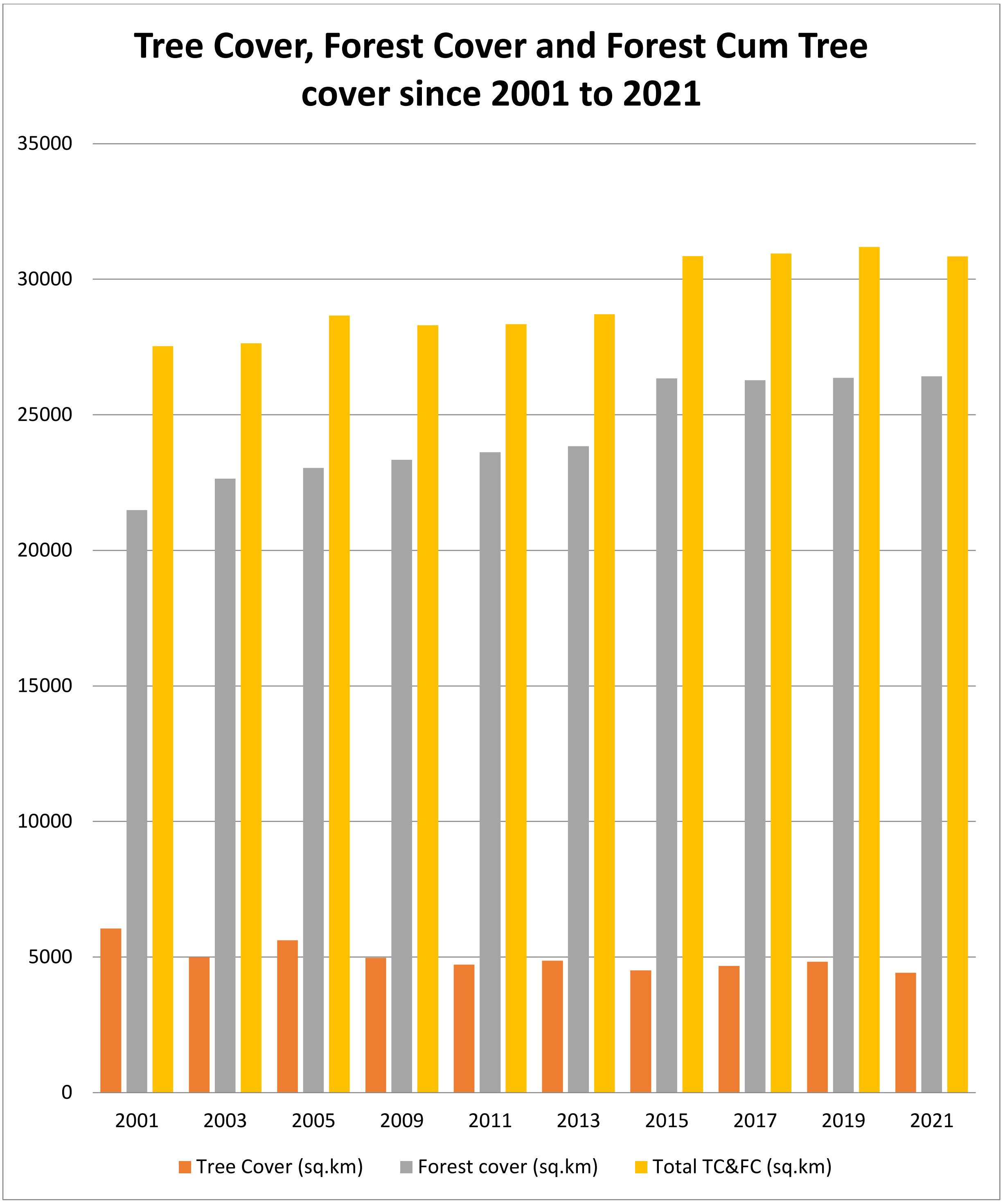
Table 6.1: Tree & Forest Cover in Tamil Nadu with respect to Total Geographical Area

Tree & Forest Cover in Tamil Nadu w.r.t Total Geographical Area (sq.km)						
Year	**Tree Cover (TC) in sq.km**	**% of TGA**	**Forest cover (FC) in sq km**	**% of TGA**	**Total TC&FC**	**% of TGA**
2001	6054	4.65%	21482	16.52%	27536	21.17%
2003	4991	3.84%	22643	17.41%	27634	21.25%
2005	5621	4.32%	23044	17.72%	28665	22.04%
2009	4968	3.82%	23338	17.94%	28306	21.76%
2011	4718	3.63%	23625	18.16%	28343	21.79%
2013	4866	3.74%	23844	18.33%	28710	22.07%
2015	4505	3.46%	26345	20.26%	30850	23.72%
2017	4671	3.59%	26281	20.21%	30952	23.80%
2019	4830	3.71%	26364.02	20.27%	31194.02	23.98%
2021	4424	3.40%	26419.23	20.31%	30843.23	23.71%

There is a gradual decrease in the Tree Cover area of Tamil Nadu from 2001 to 2021. At the same time, there is a significant increase in Forest Cover which boosts the State's Tree and Forest Cover every year. As per ISFR 2021, Tamil Nadu had a tree cover spanning 4424 square kilometres, as against 4830 sq.km reported in 2019, which translates to a loss of 406 sq.km. despite that the forest cover witnessed a tangible increase of 55.21 sq.km.

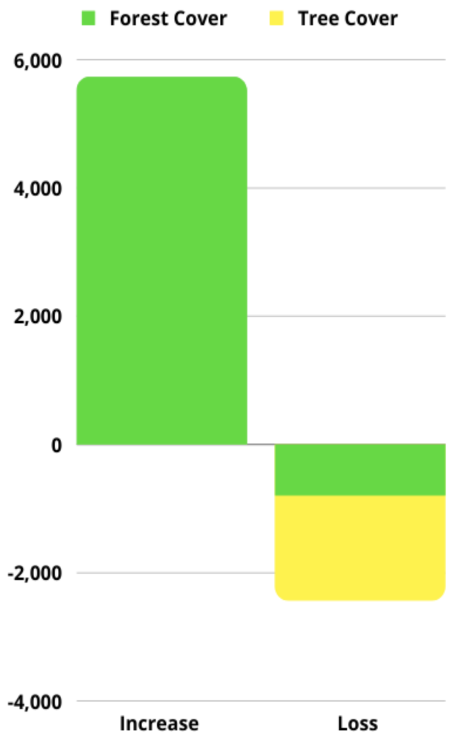
Figure 6.1 shows the steady decrease in the tree cover of the state from 2001 to 2021, but the total forest cover area of the state during this period has increased by many folds which means that the contribution of large green patches more than 1 hectare of area has steadily increased but the state has lost about 1630 sq.km of the smaller patches of trees or groves in the area outside the recorded forest area. This may be due to several reasons like urbanisation, increasing developmental activities, cyclones, drought, linear developments etc., This inference from the data in the table and graph suggests the State Government to closely monitor the smaller green patches. If possible, mapping of these smaller green patches can also be carried out using high resolution satellite images.

Figure 6.1: Tree Cover, Forest Cover and Forest cum tree cover



Though the total forest cover area increased between 2001 and 2021, the tree cover was lost to an extend of 1630 sq. km during this period. However, the significant increase in the forest cover of some districts has contributed to the increase in the total forest and tree cover area of the state.

Figure 6.2: Net change in forest cover and tree cover



NET CHANGE IN FOREST COVER AND TREE COVER BETWEEN 2001 AND 2021

Year	Tree Cover (sq.km)	Forest cover (sq.km)	Total TC&FC (sq.km)
2001	6054	21482	27536
2021	4424	26419.23	30843.23

- Between 2001 and 2021, 5 districts have recorded a loss of about 786.63 sq.km of forest cover while the total increase in forest cover of the other districts was 5723.86 sq.km.
- With respect to the Tree Cover, there is a loss of about -1630 sq.km between 2001 and 2021
- However, the net gain in forest and tree cover in Tamil Nadu between 2001 and 2021 is about 3307 sq.km

Figure 6.2 shows the net gain and loss in the tree cover and the forest cover of the state between 2001 and 2021. The gain in the forest cover area has been 5723.86 sq. km while there is a loss of about 786.63 sq.km in 5 districts (Refer table 3.3). therefore, the net gain in the forest cover is 4937.23 sq.km. With respect to the tree cover, there is a net loss of 1630 sq.km (i.e 6054 sq.km – 4424 sq.km) during this period. Considering these two parameters (tree cover & forest cover), the overall gain in the total tree cover and forest cover (TC&FC) in Tamil Nadu is 3307.23 sq.km during the period 2001 to 2021.

7. ANALYSIS ON THE MANGROVE COVER

Mangrove forests are considered as the most productive wetlands. These provide critical habitat for a diverse marine and terrestrial flora and fauna. Healthy mangrove forest is a key to a healthy marine ecology. Mangrove forests fix more carbon dioxide per unit area than phytoplankton in tropical oceans. Yet, these unique coastal tropical forests are among the most threatened habitats in the world. They may be disappearing more quickly than any other forests; therefore, it can be considered to be the most sensitive eco-system.

Mangroves perform a number of vital ecological functions in nutrient recycling, maintenance of hydrological regime, coastal protection and fish-fauna production, all of which are vital for the sustenance of human and animal life. Economically too, mangroves provide firewood, timber, fodder, fruits, medicines, honey etc. Their importance has increased because of their protective role during the disasters like cyclones and tsunami.

Biotic pressure and natural calamities play a major role in negatively impacting the mangrove ecosystems. Growing land reclamation for agriculture and industrialization along the coastlines and discharge of untreated domestic sewage and industrial effluents are damaging to these forests. Upstream activities related to river training and natural erosion and accretion also have affected the health of Mangroves since an adequate ecological flow in the rivers is essential for flushing of the Mangroves of silt and other wastes. Many studies have highlighted these problems and intensive conservation efforts are needed to ensure the survival of these sensitive ecosystems.

7.1 STATUS OF MANGROVES IN INDIA

Mangroves in India account for about 5% of the world's mangrove vegetation and are spread over an area of about 4,500 km along the coastal States/UTs of the country (Figure 7.1). Sundarbans in West Bengal accounts for a little less than half of the total area under mangroves in India, followed by the mangroves in Gujarat and Andaman & Nicobar Islands.

The Forest Survey of India is assessing the mangroves using remote sensing since beginning. It published its first assessment on mangroves in 1987 and area estimated was 4,046 km² (scale of assessment - 1:1 million). Subsequently, from 1989 to 1999 the Mangrove cover was assessed regularly on a two-year cycle at 1:250,000 scale. Assessment from 2001 onwards has been carried out at 1:50,000 scale.

7.2 MANGROVE COVER IN TAMIL NADU

ISFR 2021 (Figure 7.2) states that the mangrove cover in the State is 44.94 sq km, which is 0.035 % of the State total geographical area. The Very Dense mangrove comprises 1.11 sq. km of the mangrove cover, Moderately Dense mangrove is 26.95 sq. km while open mangroves constitute an area of 16.88 sq.km (table 7.1 & 7.2).

Figure 7.1 Mangrove forest

7.3 DISTRICT WISE MANGROVES COVER (ISFR 2021)

Table 7.1: District wise Mangrove cover in Tamil Nadu

Districts	**Very Dense Mangrove**	**Moderately Dense Mangrove**	**Open Mangrove**	**Total Area in sq.km**
Cuddalore	0.00	7.05	0.68	7.73
Nagapattinam	0.00	1.10	1.87	2.97
Pudukkottai	0.67	0.46	0.80	1.93
Ramanathapuram	0.44	0.71	1.37	2.52
Thanjavur	0.00	8.96	3.34	12.30
Tiruvallur	0.00	0.00	0.93	0.93
Tiruvarur	0.00	7.82	4.94	12.76
Thoothukudi	0.00	0.85	2.95	3.80
Total	**1.11**	**26.95**	**16.88**	**44.94**

The major patches of mangroves in the state are,

1. Pichavaram mangroves (Cuddalore)
2. Muthupet (Nagapattinam, Tiruvarur & Thanjavur)
3. Mimisal in Pudukkottai
4. Devipattnam group of mangroves in Ramanathapuram
5. Punnakayal in Thoothukudi
6. Ennore in Thiruvallur

Figure 7.2: Mangroves in Tamil Nadu

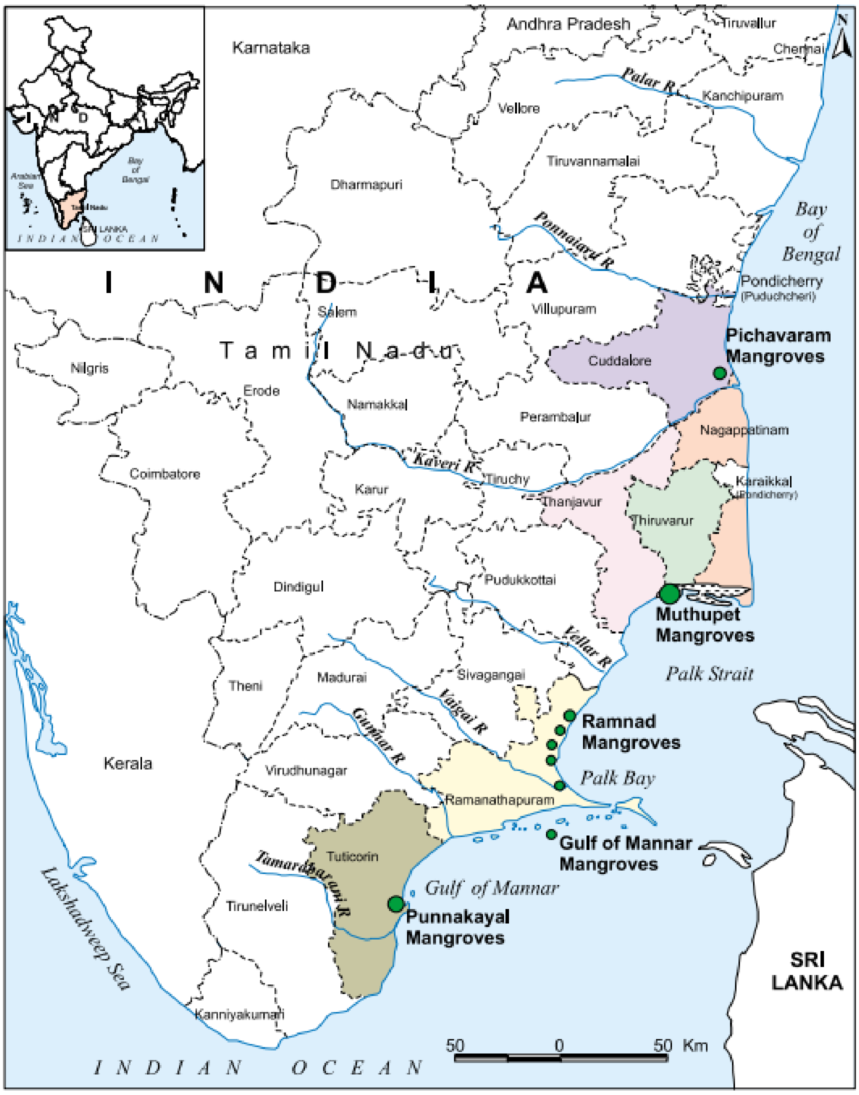


Table 7.2: Major and minor mangrove wetlands of Tamil Nadu

Major and minor mangrove wetlands of Tamil Nadu (2002 :Atlas of Mangroves in TN)		
Location-District and estuary	**Name of the Mangrove wetland**	**Area (ha)**
Cuddalore: Uppanar- Coleroon estuarine region	Pichavaram	1357
Thanjavur: Coleroon estuarine region	Pudhupattinam	800
Thiruvarur-Thanjavur: Distributaries of Vennar	Muthupet	12000
Ramanathapuram: islands of the Gulf of Mannar	Gulf of Mannar Marine National Park	30
Ramanathapuram: At the mouth of small tidal creeks at 11 places in the mainland	Palk Strait	700
Tuticorin: Tamirabarani estuary National Park	Gulf of Mannar Marine National Park	148

7.4 MANGROVE COVER OF TN vs MANGROVE COVER OF INDIA

The following table summarizes the mangrove cover assessment from 2001 to 2021 (Table 7.3). The share of Tamil Nadu's mangrove to the national mangrove cover is only 0.9%. Despite of the very less extent of mangrove in the state in comparison to the other states, the state has shown increasing trend in the area of the mangrove cover from 23 sq.km. in 2001 to 49 sq.km in 2017. But Tamil Nadu had lost 4 sq.km of the mangrove cover between 2017 and 2021.

Table 7.3: Mangrove cover of India

States	2001	2003	2005	2009	2011	2013	2015	2017	2019	2021	% of India's Mangrove cover
Andhra Pradesh	333	329	354	353	352	352	367	404	404	405	8.11
Goa	5	16	16	17	22	22	26	26	26	27	0.54
Gujarat	911	916	991	1,046	1,058	1,103	1,107	1,140	1,177	1,175	23.54
Karnataka	2	3	3	3	3	3	3	10	10	13	0.26
Kerala	0	8	5	5	6	6	9	9	9	9	0.18
Maharashtra	118	158	186	186	186	186	222	304	320	324	6.49
Odisha	219	203	217	221	222	213	231	243	251	259	5.19
Tamil Nadu	23	35	36	39	39	39	47	49	45	45	0.90
West Bengal	2,081	2,120	2,136	2,152	2,155	2,097	2,106	2,114	2,112	2,114	42.35
A&N Islands	789	658	635	615	617	604	617	617	616	616	12.34
Daman& Diu	0	1	1	1	2	1.63	3	3	3	3	0.06
Puducherry	1	1	1	1	1	1	2	2	2	2	0.04
Total	4,482	4,448	4,581	4,639	4,663	4,628	4,740	4,921	4,975	4992	

(unit in sq.km)

7.5 TREND ANALYSIS IN THE DENSITY CLASS OF MANGROVE COVER

FSI has divided the mangrove cover intro three classes – very dense, moderately dense and open mangrove similar to that of the forest cover density classes. Though the data for each of the classes are provided separately in the ISFR reports (Figure 7.3), the value of the mangrove cover is included within the forest cover density classes for the purpose of estimation of the state's forest cover. However, it is required to analyze the data of the mangrove density classes to understand the variations within the density class and to come up with suggestive measures to improve the state's mangrove cover.

1. Tamil Nadu's Mangrove cover has shown steady increase until 2017 and thereafter shows a decreasing trend.
2. The state has improved on the very dense mangroves from NIL to 1 sq.km. and has also shown good improvement in the moderately dense mangrove class by adding 9 sq.km (Table 7.4).
3. But the open mangrove category has shown an increasing trend until 2015 and thereafter reduced.
4. One observation here is that some parts of the open mangrove has improved its density and have moved to the higher density class i.e., moderately dense mangrove, as there is a spike in the moderately dense mangrove category from 2017 onwards. But some parts of open forest have deteriorated further and became less than 10% canopy density which has resulted in the loss of 4 sq.km of mangroves in the year 2019.

Figure 7.3: Mangrove density classes trend in Tamil Nadu

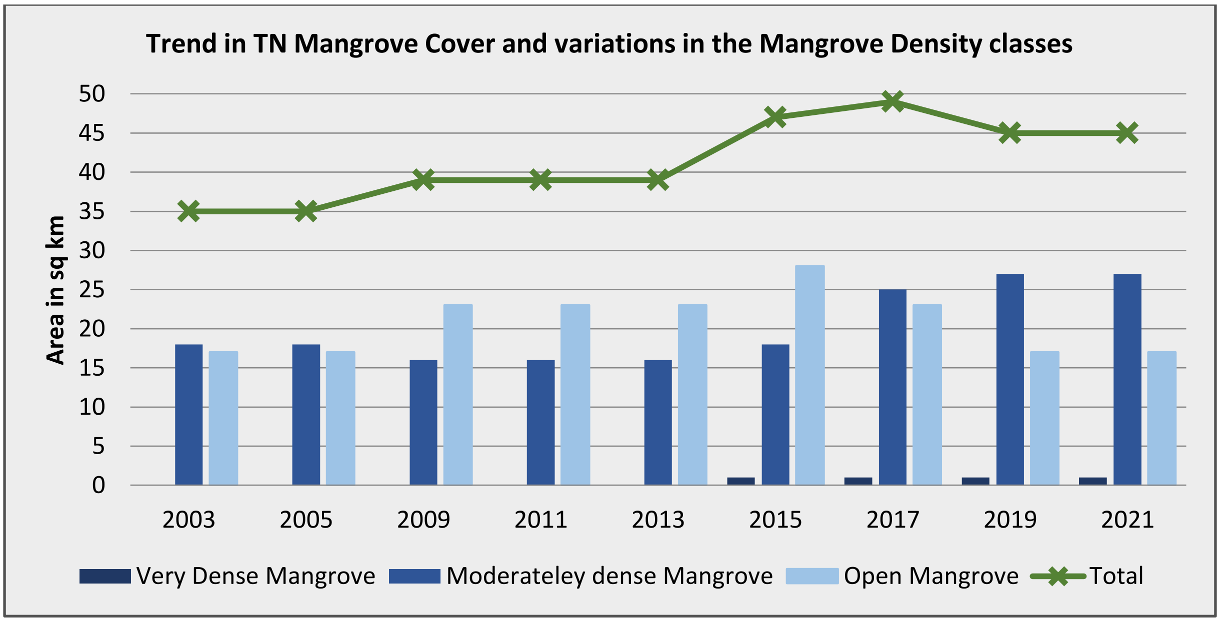


Table 7.4: Mangrove density classes of Tamil Nadu

ISFR	Very Dense Mangrove	Moderately dense Mangrove	Open Mangrove	Total	Change
2003	0	18	17	35	12
2005	0	18	17	35	0
2009	0	16	23	39	3
2011	0	16	23	39	0
2013	0	16	23	39	0
2015	1	18	28	47	8
2017	1	25	23	49	2
2019	1	27	17	45	-4
2021	1	27	17	45	0

7.6 DISTRIBUTION OF MANGROVES WITHIN TAMIL NADU

The collection of data from the Mangrove Cover section of the ISFR 2003 to 2021 is given below (table 7.5). This shows the distribution of the mangrove in Tamil Nadu. As this data is based on the satellite images, only those mangrove patches above 1 hectare is captured. Smaller mangrove patches less than 1 hectare are not included in this list.

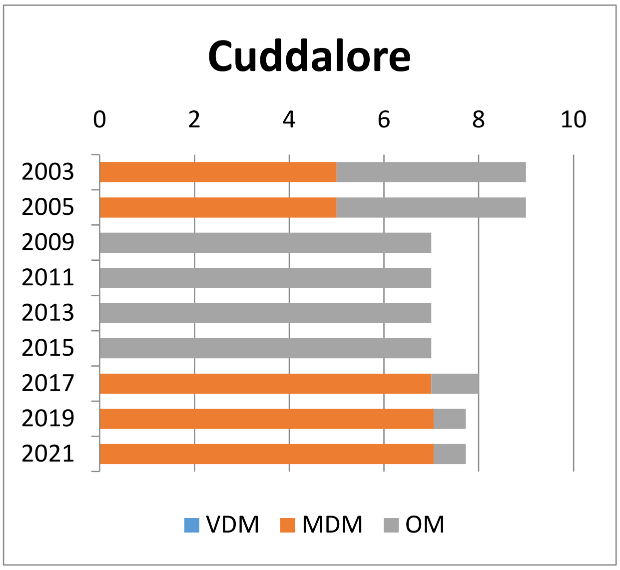
Table 7.5: Mangrove distribution in Tamil Nadu

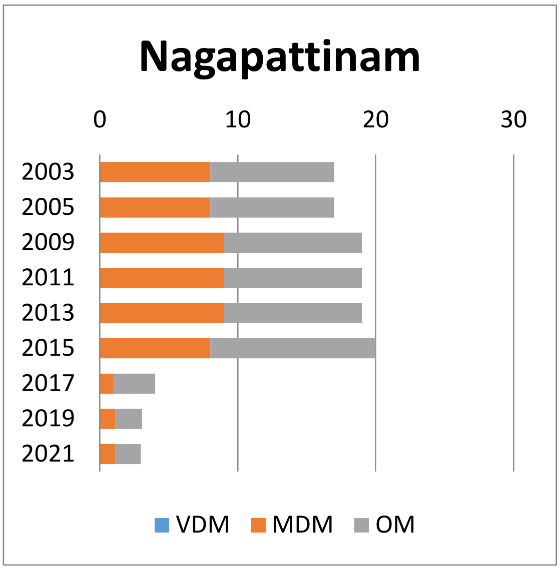
Mangrove Distribution in Tamil Nadu	2003	2005	2009	2011	2013	2015	2017	2019	2021
Cuddalore	9	9	7	7	7	7	8	7.73	7.73
Nagapattinam	17	17	19	19	19	20	4	3.05	2.97
Pudukkottai	0	0	0	0	0	1	2	1.9	1.93
Ramanathapuram	1	1	3	3	3	3	2	2.34	2.52
Thanjavur	8	8	8	8	8	12	12	12.3	12.3
Thoothukudi	0	0	2	2	2	3	4	3.8	3.8
Tiruvallur	0	0	0	0	0	1	1	0.91	0.93
Tiruvarur	0	0	0	0	0	0	16	12.9	12.76
Total Mangrove Cover	**35**	**35**	**39**	**39**	**39**	**47**	**49**	**44.8**	**44.94**

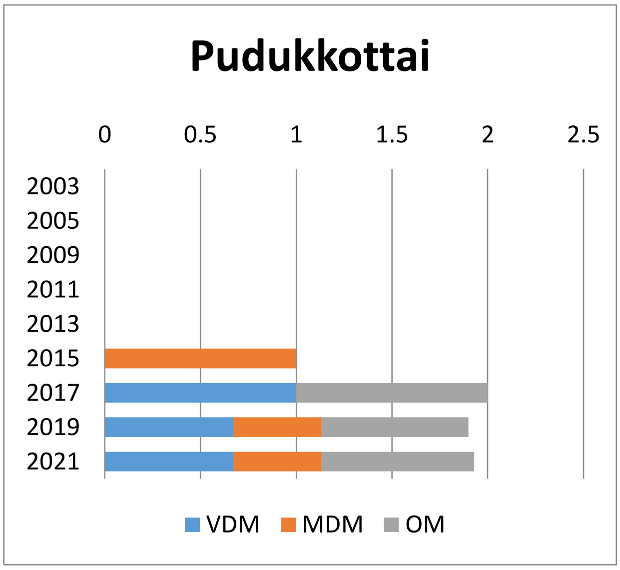
(unit in sq.km)

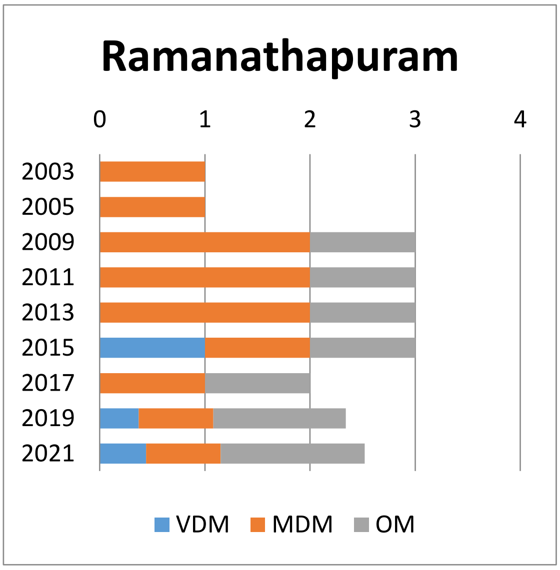
Analysis of the data in the above table is required to understand the changes in the mangrove patches in the above districts. The class wise distribution of the mangroves in districts is also available in the IFSR reports. Each of these districts were analyzed separately to know the variations in the mangroves in these districts during the period 2003 to 2021. The x-axis in the below graph indicates area in sq.km.

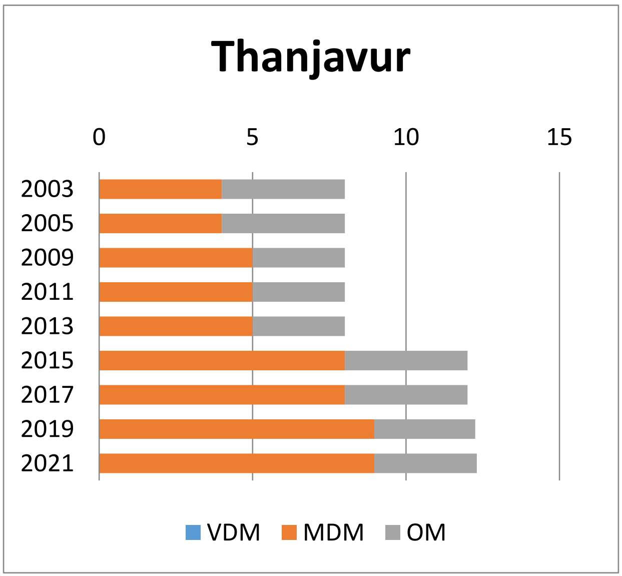
Figure 7.4: District wise Trend Analysis of Mangrove density classes

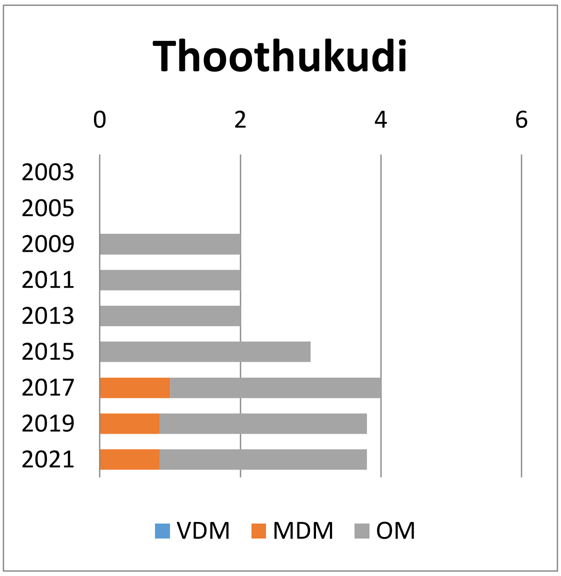


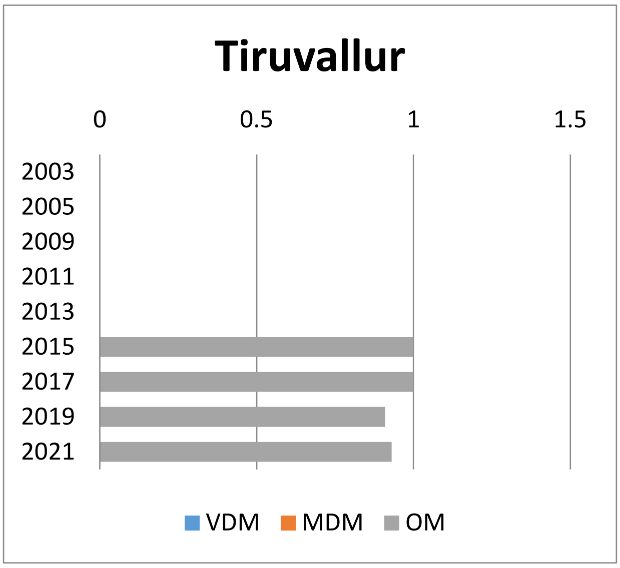


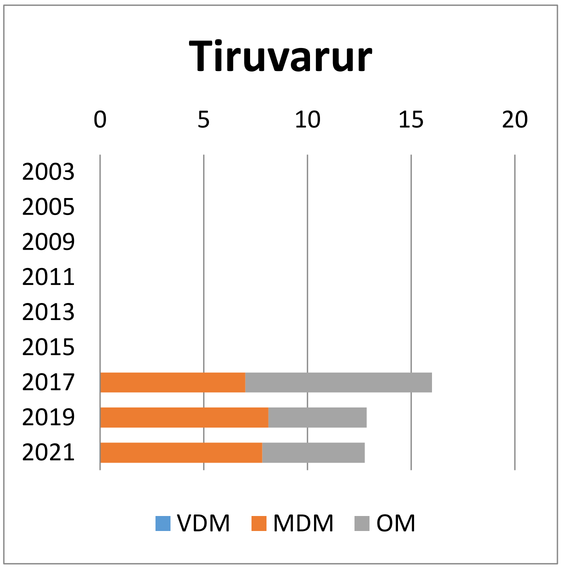












The findings of this analysis (Figure 7.4) are,

- Cuddalore has lost about 1 sq.km of the mangrove patch
- Nagapattinam has recorded a huge loss of about 17 sq kms of mangroves
- Pudukkottai has a 1 sq.km of very dense mangrove which requires protection and conservation, the district has also lost some amount of the open mangrove class.
- Ramanathapuram had increased its mangrove quality and its extent from 2003 to 2015, but thereafter it has lost a portion of very dense, moderate and open mangrove classes. Therefore, there is a huge scope for improving the mangroves in this district.
- Thanjavur has improved in the mangrove cover substantially from 8 to 12 sq.km.
- Thoothukudi has also improved the mangrove cover from 2 to 4 sq.km. There is a good scope to improve further with sustained efforts and interventions.
- Tiruvallur has Ennore creek, which has improved its density during the decade 2011-21, however this requires more protection and interventions to improve its extent beyond 1 sq.km and to improve on its density.
- Tiruvarur district has about 12.8 sq.km of mangroves, further there is a good scope to improve its extent and the quality as the district that had recorded 16 sq.km of mangrove in 2017 and due to some reasons, it had reduced to 12.8 sq.km in 2019 and 2021. The reason for this loss requires a detailed study and analysis based on which corrective measures can be initiated.

8. DISTRICT WISE ANALYSIS OF THE FOREST COVER

Though Tamil Nadu as a state has recorded about 23.7% of total forest and tree cover as per the ISFR 2021, the distribution of forest cover in all districts has not been uniform. From the previous chapters, it can be clearly understood that some districts have gained net area in the total forest cover area while some have lost a considerable area. Though few states have recorded considerable increase in the total forest cover area, they have lost area in any one of the three density classes. So, a detailed analysis of the status of forest in each district is attempted in this chapter. The comparison of the recorded forest area and the total forest cover area has also been done for available for each district. Suitable suggestions to improve the forest cover and to address any specific issue related to the forest cover has also been provided. For the purpose of analysis, 32 districts listed in the ISFR 2021 is only considered.

Figure 8.1 Districts of Tamil Nadu (2023)

1. ARIYALUR

The recorded forest area in Ariyalur district is 91.3754 sq.km. There are 55 reserved forests and 1 reserved land whose total area sums up to 91.3744 sq.km while the remaining area is unclassified forest land (TNFD 2021 data). The total forest cover area in this district has been on an increasing trend from 2003 to 2021. The total forest cover area is about 20.86% of the district's geographical area (Table 8.1.1, Figure 8.1.3). So, there is a need to pay more attention to this district to increase its green cover in the areas outside the forest. The district has only two density classes of forest cover i.e moderately dense and open forests.

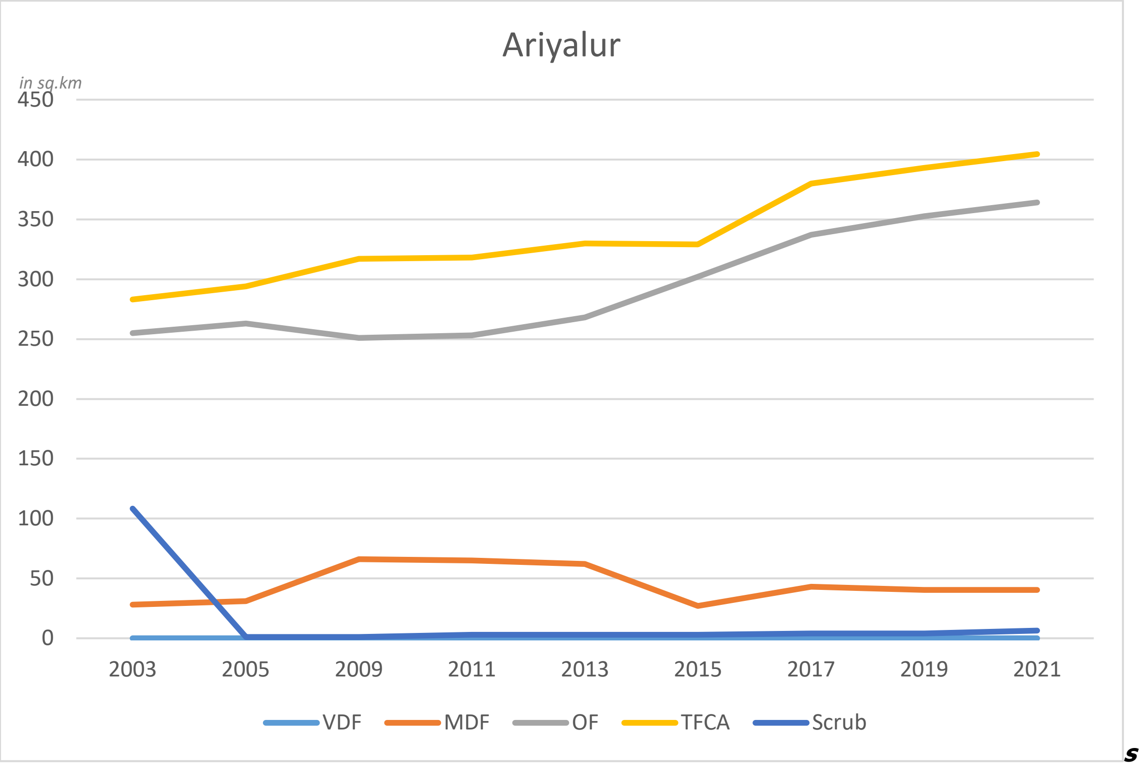
The moderately dense category of forest has recorded a varying trend during the period 2003 to 2021. This indicates that this category of forest is highly vulnerable to the effects of climate change and other external factors. The area under open forests has been increasing steadily from 2003. Considering the fluctuations in the moderately dense category of the forests, special focus has to be given to increase the green cover in this category by taking up native species planting within the recorded forest area through special schemes. There is a very high scope to improve the quality of the open forest through intensive native tree planting coupled with soil moisture work to support the existing trees which might possibly help in the conversion of this class into moderately dense forest.

Table 8.1.1: Ariyalur Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	1947	1947	1947	1947	1947	1947	1940	1940	1940
MDF	28	31	66	65	62	27	43	40.45	40.38
OF	255	263	251	253	268	302	337	352.69	364.22
TFCA	**283**	**294**	**317**	**318**	**330**	**329**	**380**	**393.14**	**404.6**
Percent	14.54	15.1	16.28	16.33	16.95	16.9	19.59	20.26	20.86
Change	-71	2	2	3	12	-1	53	13.14	11.46
Scrub	108.5	1	1	3	3	3	4	3.96	6.56

Figure 8.1.1. Trend analysis of forest in Ariyalur district



s

Figure 8.1.2. Share of Forest & non-forest area in Ariyalur district (2021)

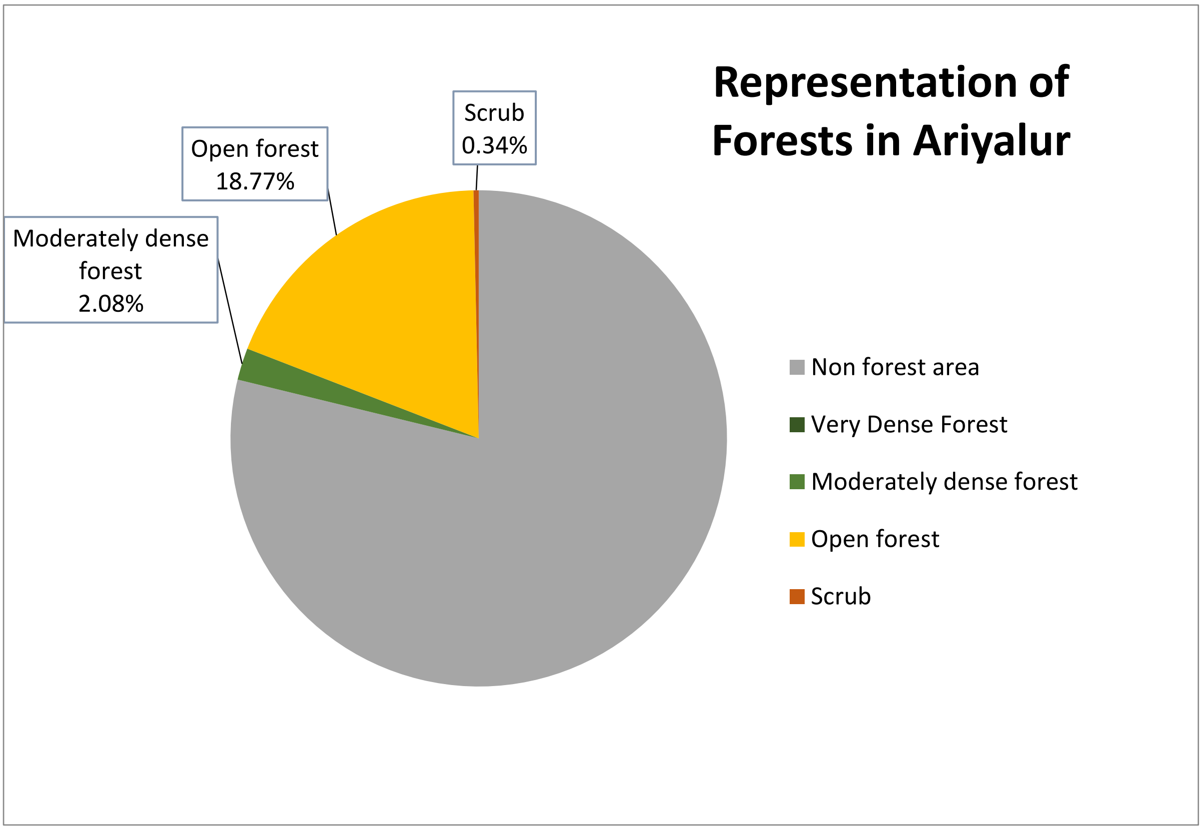


Figure 8.1.3. Forest Cover map of Ariyalur district

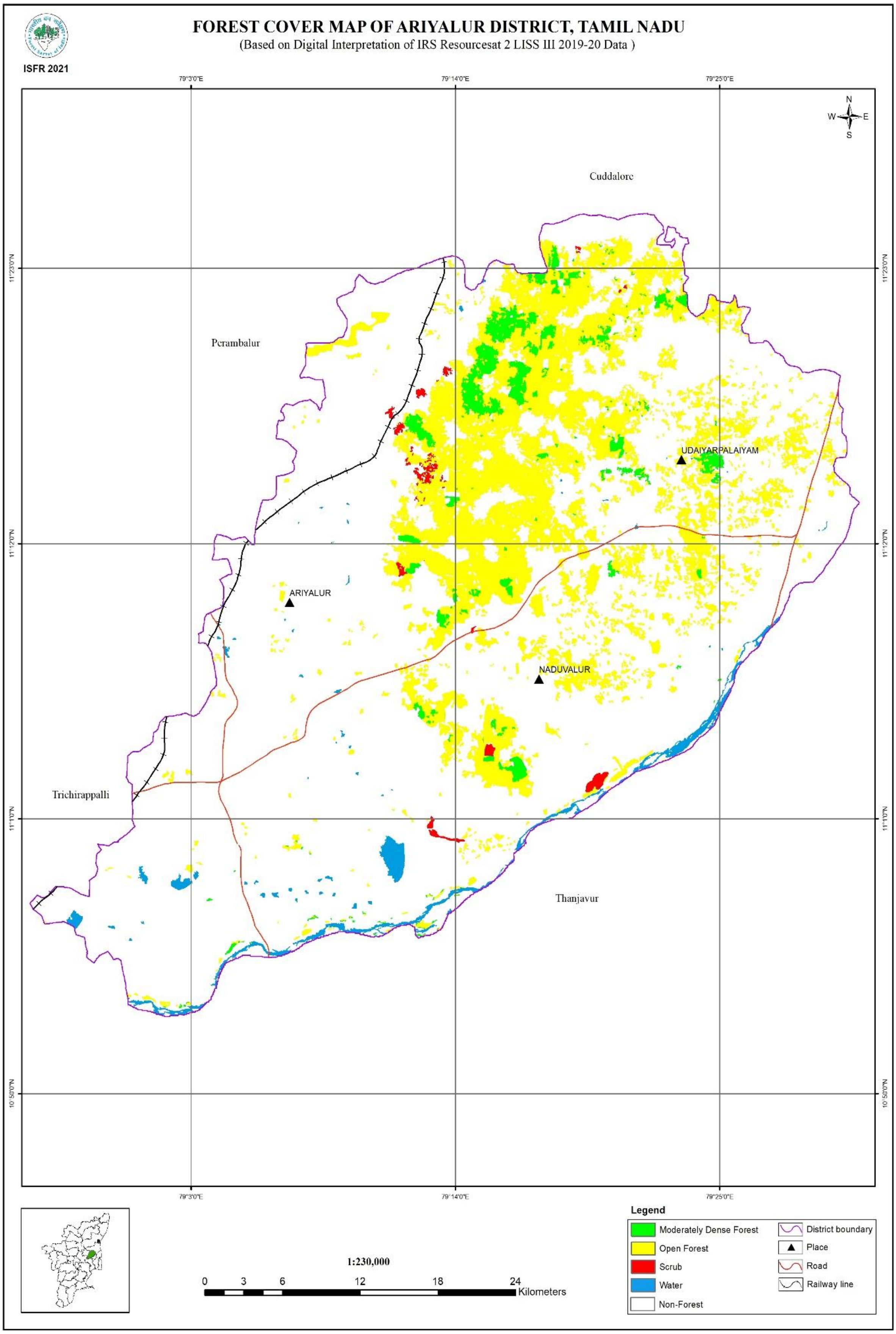
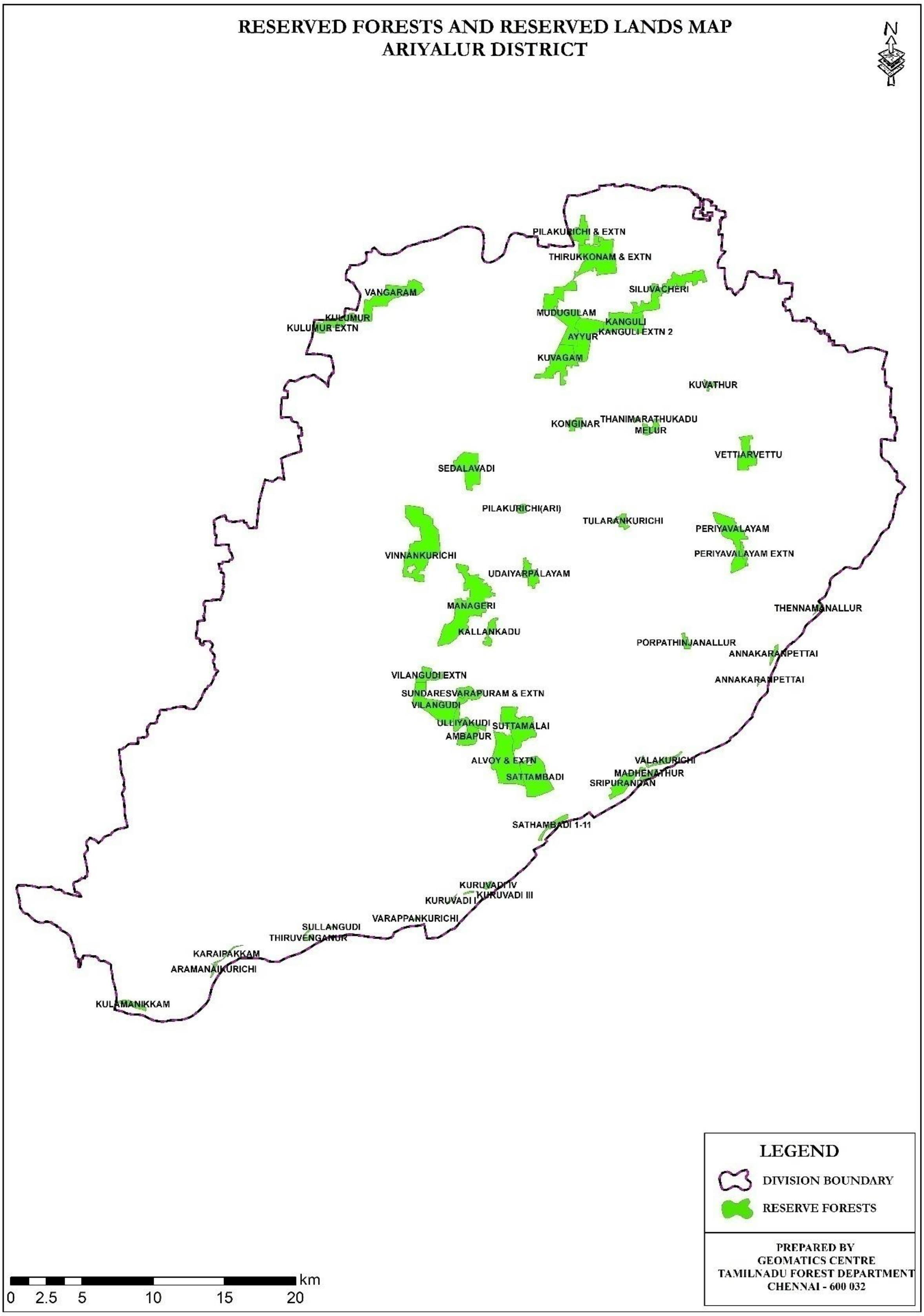


Figure 8.1.4. Map of Notified forests in Ariyalur district



2. CHENNAI

The recorded forest area in Chennai is 7.49 sq.km (Figure 8.2.4). There are 10 reserved forests and 3 reserved lands whose area sums up to 6.95 sq.km while the remaining area is unclassified forest land (TNFD 2021 data). The total forest cover area has been constantly increasing until 2017 after which there has been a decreasing trend. This district has only two density classes of forest i.e moderately dense forest and open forest. The moderately dense forest has been on increasing trend until 2017 and thereafter it is decreasing while the open forest is also showing the similar trend (Table 8.2.1). One of the major reasons could be the effect of cyclones that had uprooted many standing trees and another possible reason could be the increasing urbanization in this district being the capital of the state. So, special focus has to be given to increase the tree outside forest cover in the urban limits which will not only contribute to improve the district's tree cover but will also have effect over the raising temperature levels due to climate change.

Being the capital city region, this district needs to focus on improving its green cover. The scope of increasing the recorded forest area is minimal due to non-availability of forests and the urban pressure, but there is a good possibility to increase the tree cover in the areas outside the forest through specialized programmes. A dedicated urban forestry wing can be created in the Greater Chennai corporation that would focus on increasing the city's green cover. River side plantations and creation of green buffer zones surrounding the water bodies or residential complexes are some of the options that can be tried out in association with corporates and residential associations.

Table 8.2.1: Chennai Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	144	144	144	144	144	144	175	175	175
MDF	3	3	5	6	6	7	7	6.34	6.17
OF	3	3	4	3	5	6	7	6.5	6.5
TFCA	**6**	**6**	**9**	**9**	**11**	**13**	**14**	**12.84**	**12.67**
Percent	4.17	4.17	6.25	6.25	7.64	9.03	8	7.34	7.24
Change	1	0	0	0	2	2	-2	-1.16	-0.17
Scrub	0.5	0	0	0	0	0	0	0	0

Figure 8.2.1. Trend analysis of forest in Chennai district

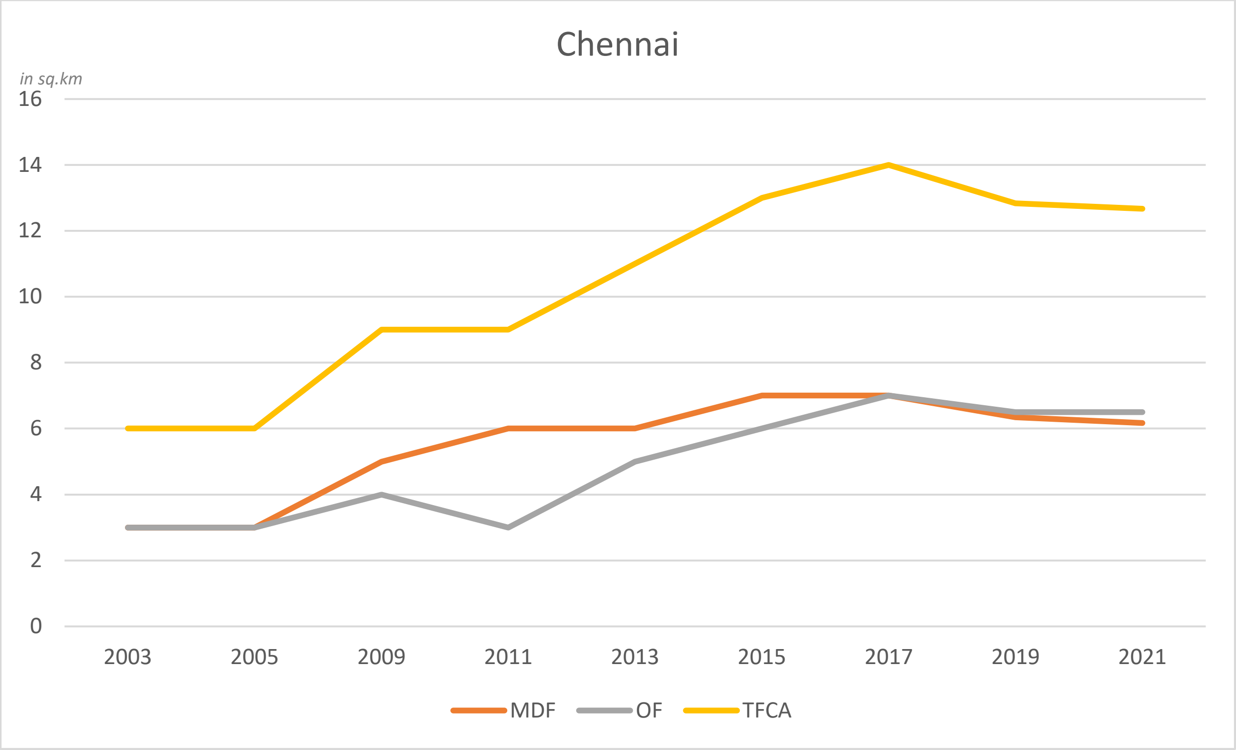


Figure 8.2.2. Share of Forest & non-forest area in Chennai district 2021

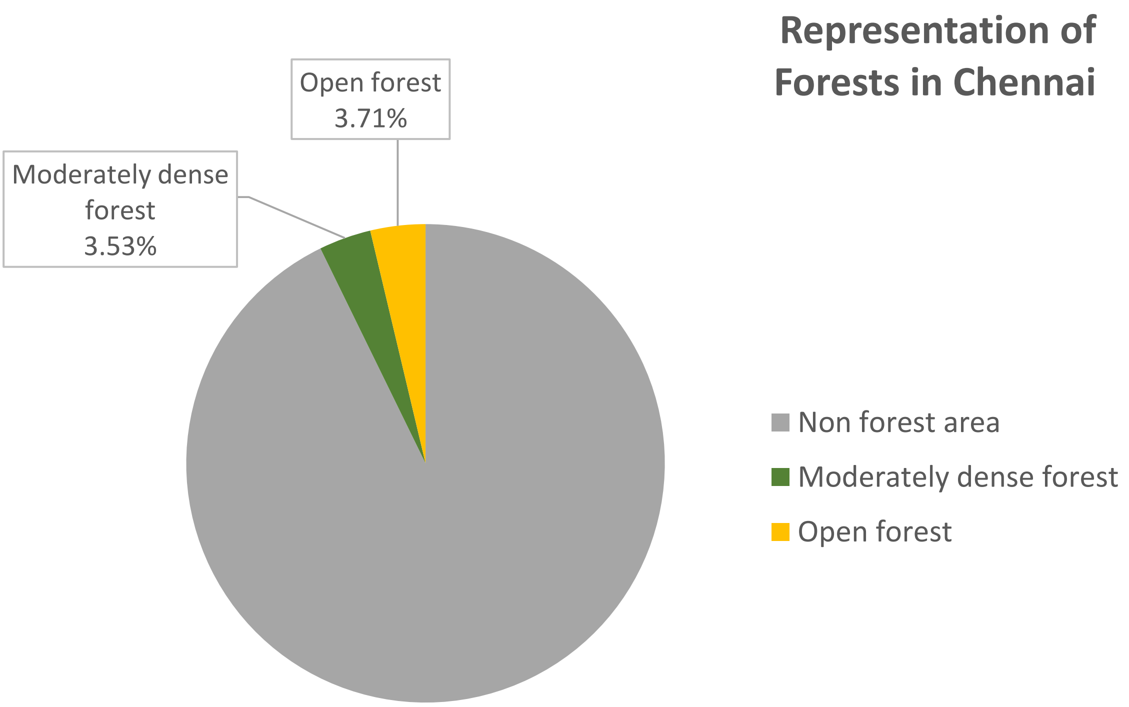


Figure 8.2.3. Forest Cover map of Chennai district

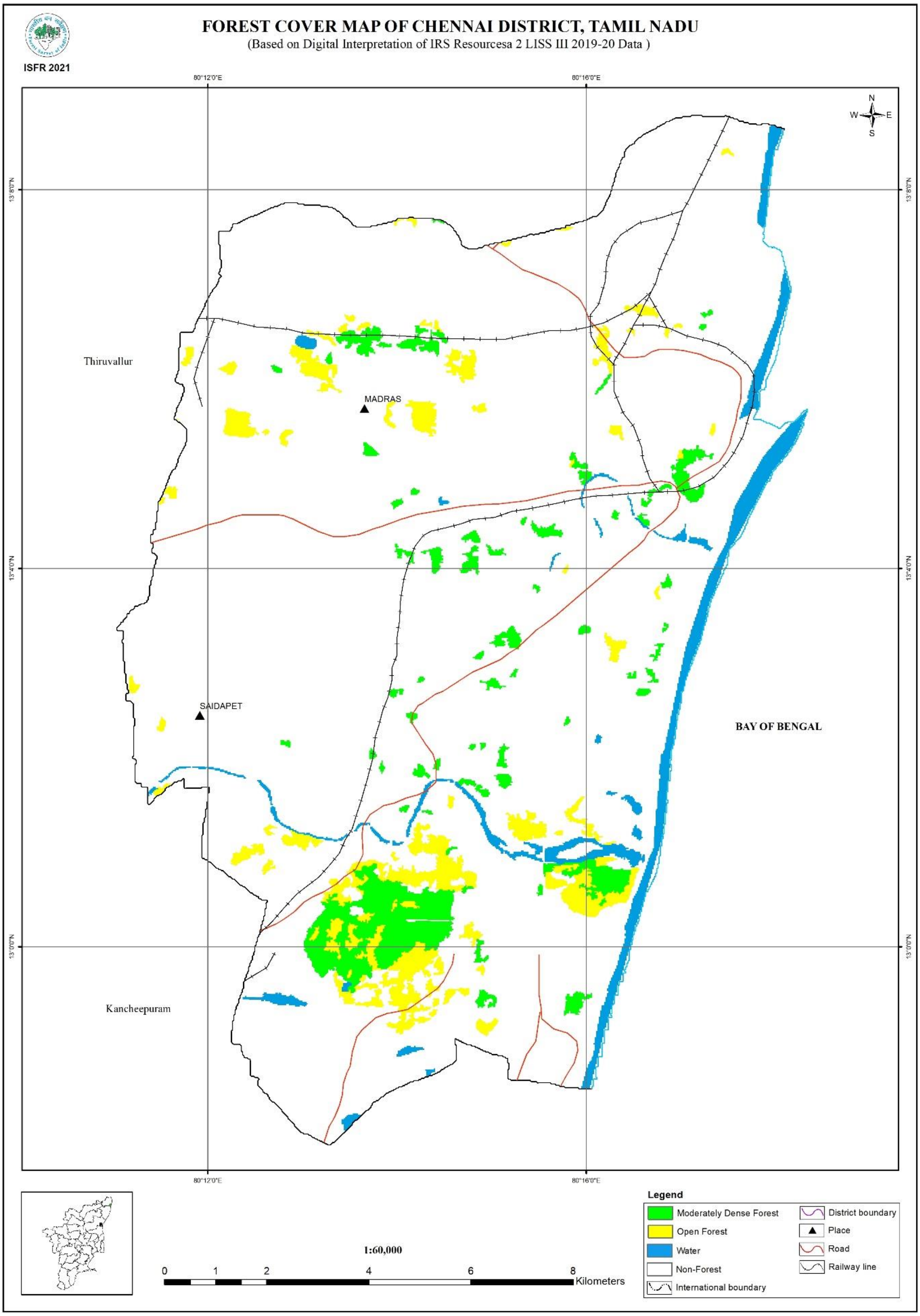
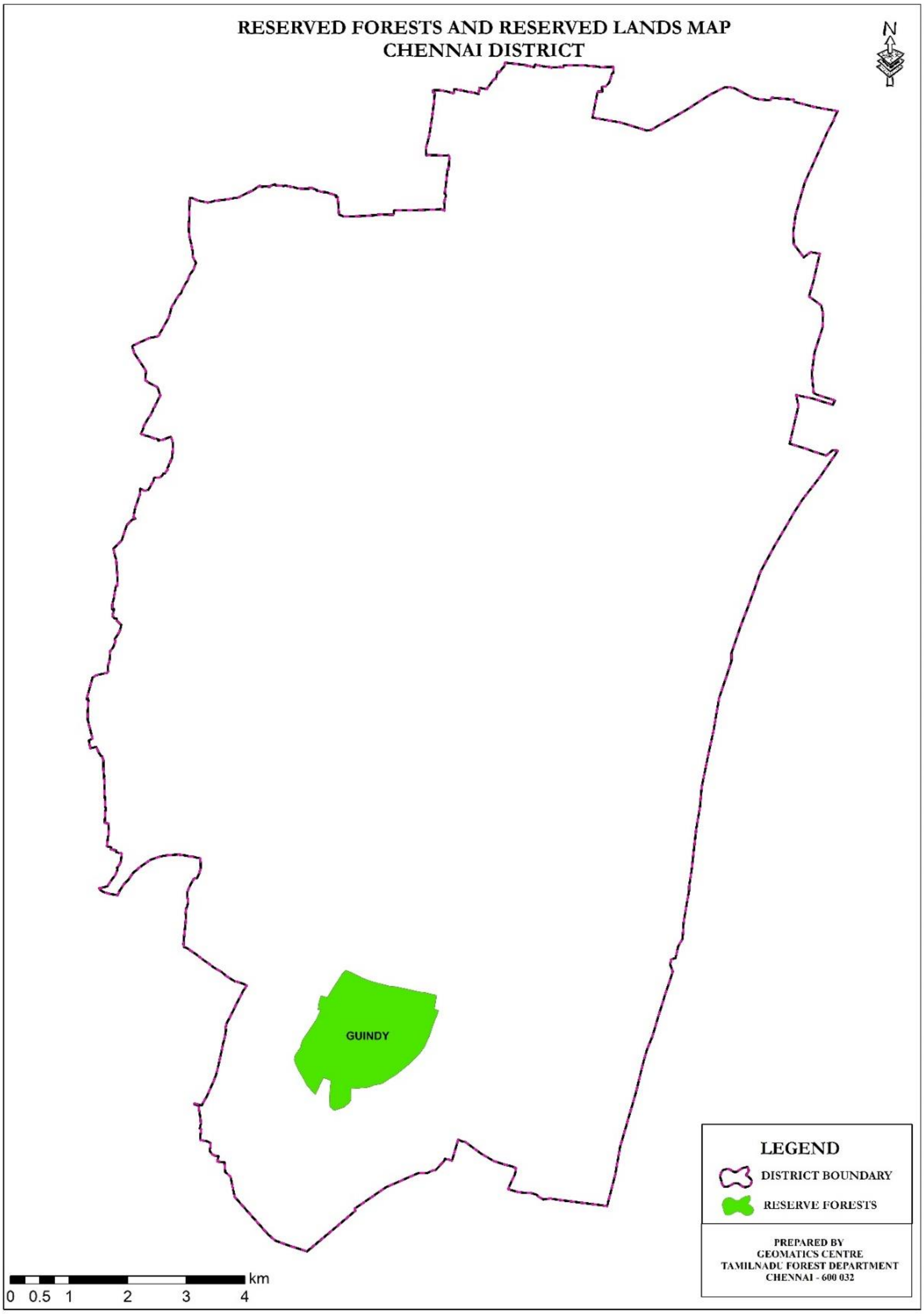


Figure 8.2.4. Map of Notified forests in Chennai district



3. COIMBATORE

Coimbatore comes second next to Erode in terms of forest cover area in the state which is close to 1985 sq.km. as per IFSR 2021. The erstwhile Coimbatore district includes parts of the present Tiruppur district. Tiruppur district was carved out from parts of Coimbatore district and Erode district in 2009, but FSI has accounted this bifurcation only from IFSR 2017. For the purpose of better understanding, the analysis of these 3 districts is done in contiguity. Presently there are 32 reserved forests and 6 reserved lands in Coimbatore. The total recorded forest area in this district is 1427.55 sq.km. out of which 1222.19 sq.km. (Figure 8.3.4) constitutes the reserved forest and reserved lands and the rest is unclassified forest lands.

The very dense forest class of Coimbatore has reduced from 405 to 377 sq.km. between 2003 to 2015 while there is increase in the moderately dense forest class. Green cover of Coimbatore was 35.17% of the total geographical area during 2015 and after the bifurcation the share has increased to about 41%. The district has to focus more on the dense and moderately dense forest class by taking up activities under forest management to improve the canopy density of these classes there by increasing the possibility of changing a good portion of the moderately dense forest class into dense forest class.

During the period 2015 to 2017, both the moderate forest and open forest classes have reduced in area which has affected the total forest cover as well. As IFSR accounts the formation of Tiruppur as a separate district in the 2017report, this is one of the reasons for the drop. A deeper analysis to examine other factors for this drop in area can help to identify the issues faced by the forest in this district. With respect to Scrub forests only 7.3 sq.km. is estimated in Coimbatore. Being one of the most developed districts in the state, the locational advantage of the Western Ghats and the geographical advantage of many water bodies should be well utilized to improve the districts green cover in the areas outside the forest as green buffer zones, road side plantation, city parks etc., A dedicated urban forestry wing may be created in the Coimbatore corporation to take up these works in association with local forest department.

Table 8.3.1: Coimbatore Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	7469	7469	7469	7469	7469	7469	4732	4732	4732
VDF	405	424	379	381	381	377	364	360.8	360.8
MDF	833	815	951	922	932	943	669	680.01	679.98
OF	566	567	540	527	547	1307	942	943.83	944.26
TFCA	**1804**	**1806**	**1870**	**1830**	**1860**	**2627**	**1975**	**1984.64**	**1985.04**
Percent	24.15	24.18	25.04	24.5	24.9	35.17	41.74	41.94	41.95
Change	12	0	-5	3	30	767	-3	9.64	0.4
Scrub	12.5	25	15	18	24	4	1	7.01	7.31

Figure 8.3.1. Trend Analysis of Forest in Coimbatore district

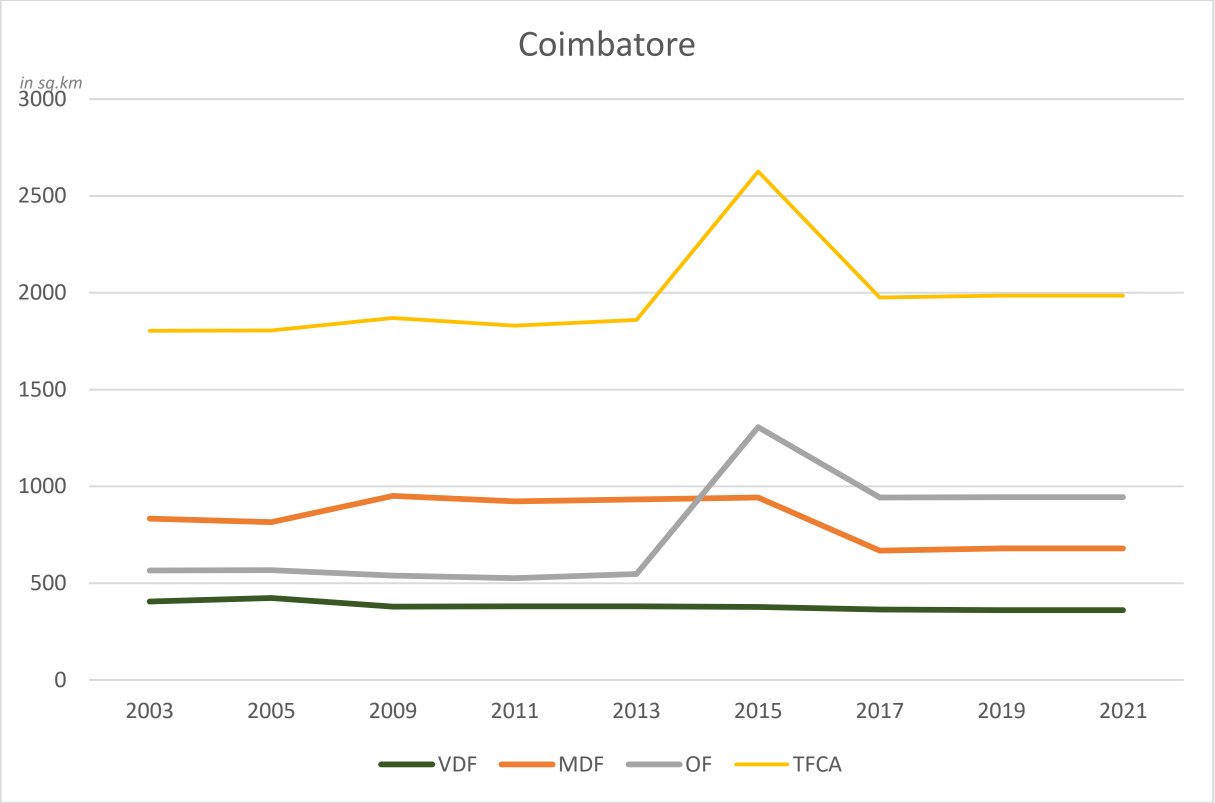


Figure 8.3.2. Share of Forest & non-forest area in Coimbatore district (2021)

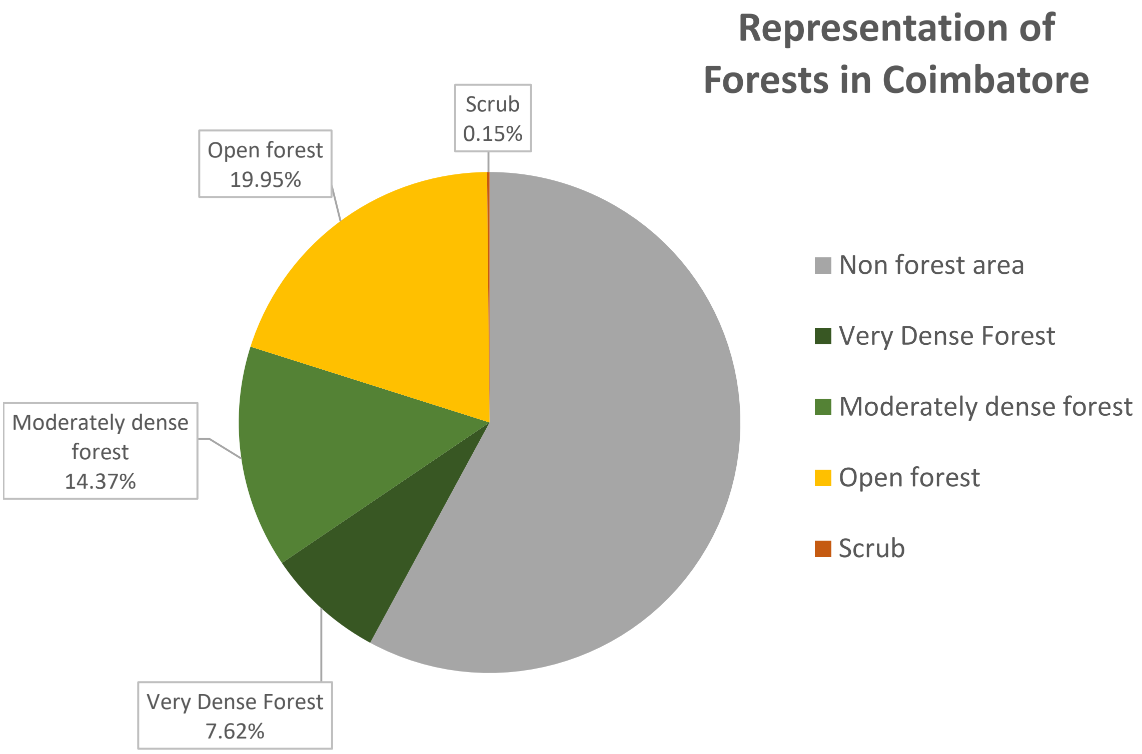


Figure 8.3.3. Forest Cover map of Coimbatore district

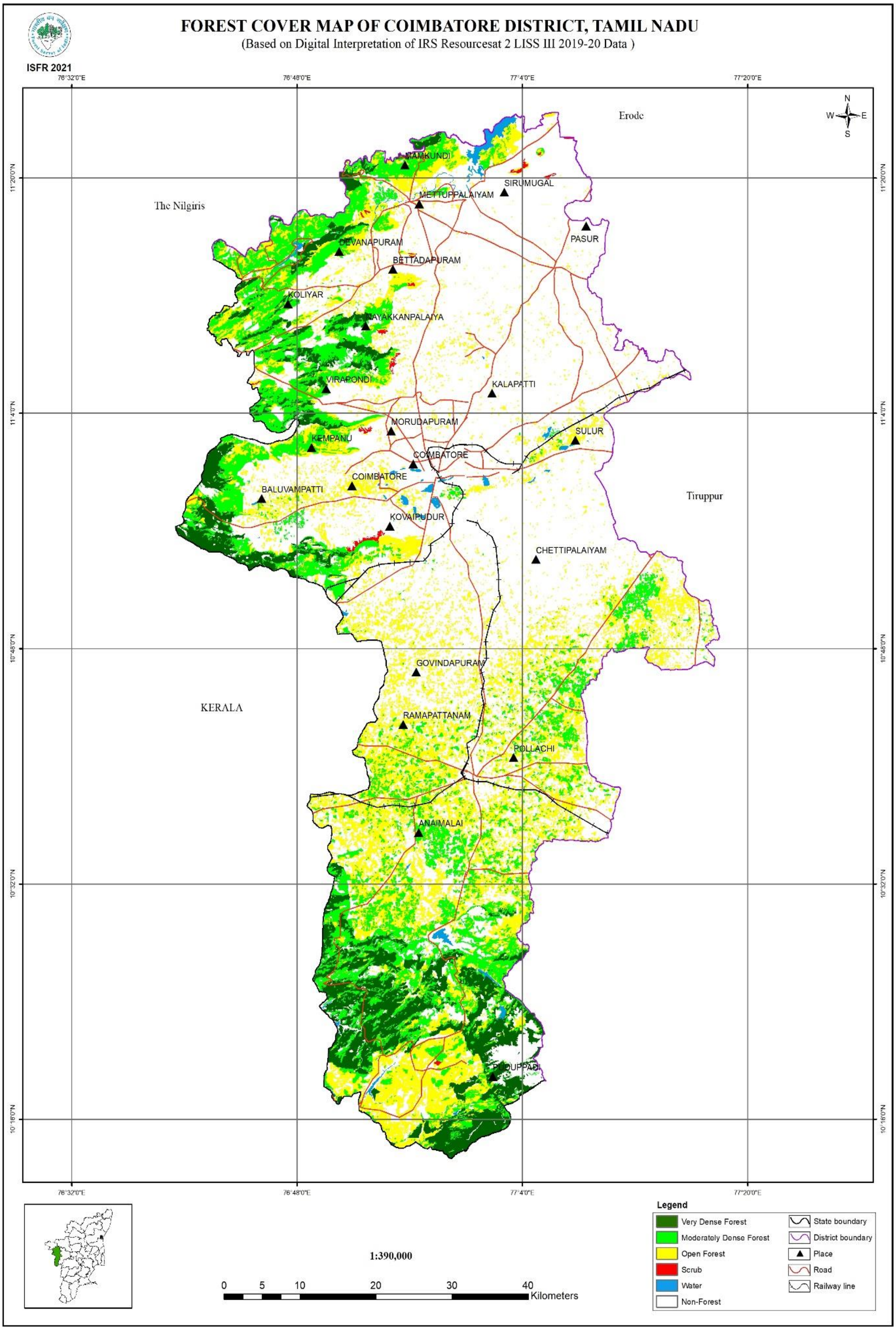
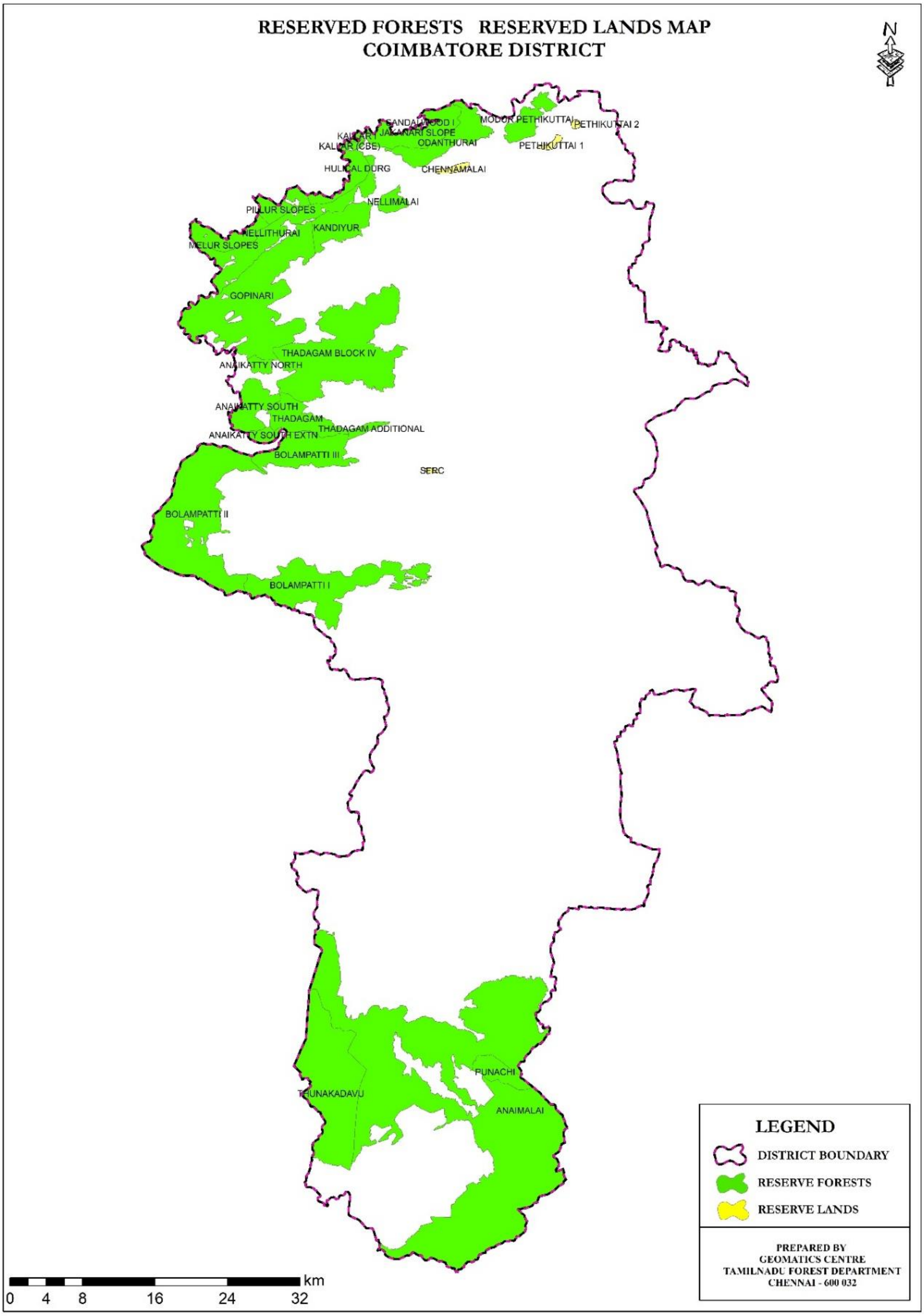


Figure 8.3.4. Map of notified Forest map in Coimbatore district



4. ERODE

Erode stands first in the state with respect to the forest cover area as per the ISFR 2021 which is about 2295 sq.km. This district had a geographical area of about 8209 sq.km., later a part of the district was carved out along with some parts from Coimbatore district to form a new district "Tiruppur". At present, the percentage of green cover in this district is close to 40%. This district has three density classes of forest – very dense, moderately dense and open forests. The area of the very dense forest has increased during the first decade (2003 to 2015), after 2015 the area in this category is showing a negative trend while the moderately dense forest area was decreasing during the first decade (2003 to 2015) & there on the area remains unchanged after the 2015. The open forest category is also showing a similar trend of decrease until 2011 and then its constantly increasing until 2021.

A good portion of the area is occupied by the scrub forest (<10% canopy class) which is about 37.5 sq.km., so this indicates that focused operations to increase the green cover in this area will yield good results to increase the district's green cover. As Tiger, Elephant and Vulture are the three most popular fauna known in this region, special focus has to be given to those tree species that are associated to these species. Establishment of fodder banks for elephants can also help in reducing the wildlife conflict and crop damage cases in this district while contributing to the green cover.

Table 8.4.1: Erode Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	8209	8209	8209	8209	8209	8209	5760	5760	5760
VDF	378	378	439	468	467	485	408	402.17	402.17
MDF	1174	1174	1409	1371	1341	1285	1127	1128.56	1128.56
OF	678	678	367	366	402	651	772	763.73	765
TFCA	2230	2230	2215	2205	2210	2421	2307	2294.46	2295.73
Percent	27.17	27.17	26.98	26.86	26.92	29.49	40.05	39.83	39.86
Change	83	0	1	1	5	211	9	-12.54	1.27
Scrub	24	40	37	40	44	29	32	36.73	37.5

Figure 8.4.1. Trend analysis of Forest in Erode district

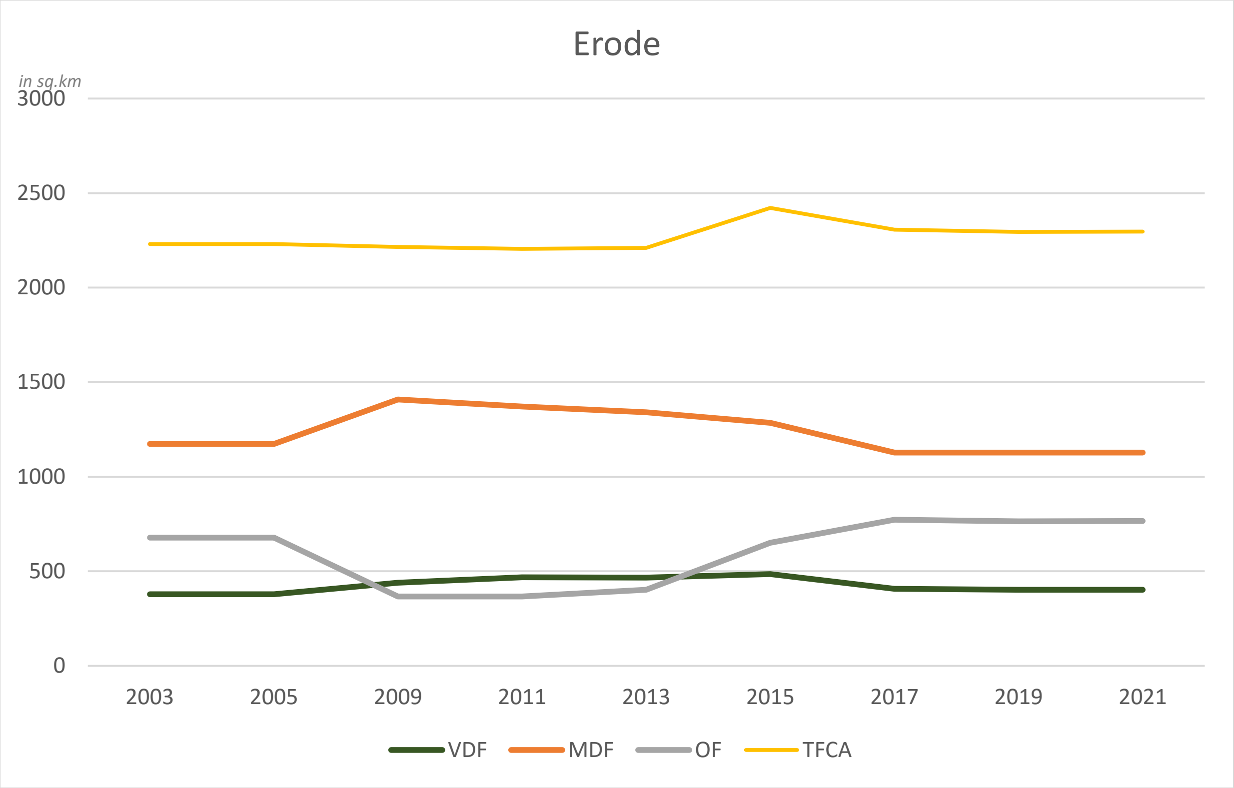


Figure 8.4.2. Share of Forest & non-forest area in Erode district (2021)

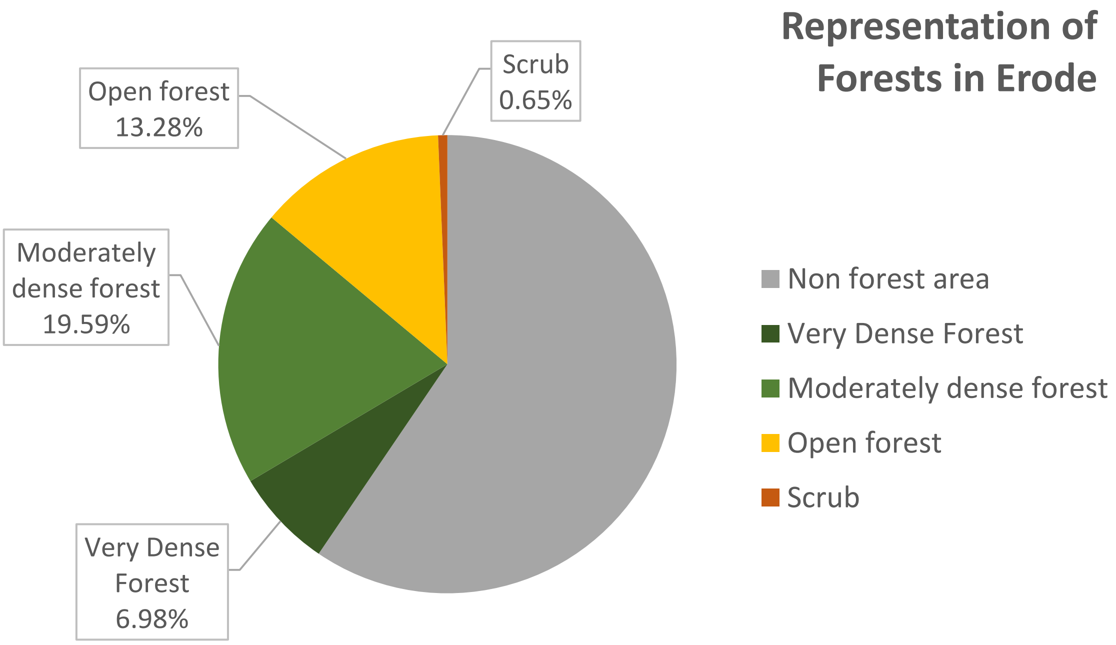


Figure 8.4.3. Forest Cover map of Erode district

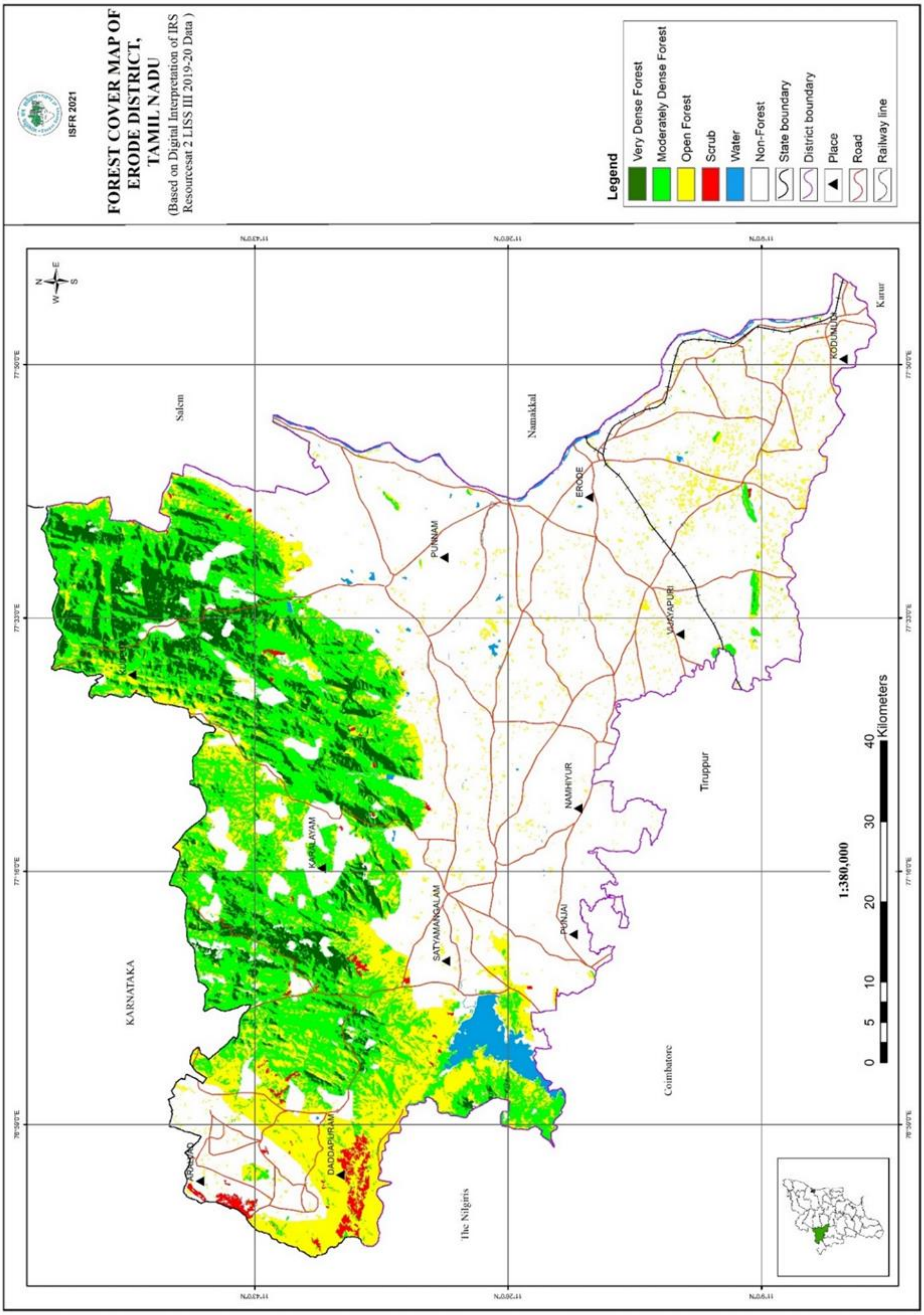
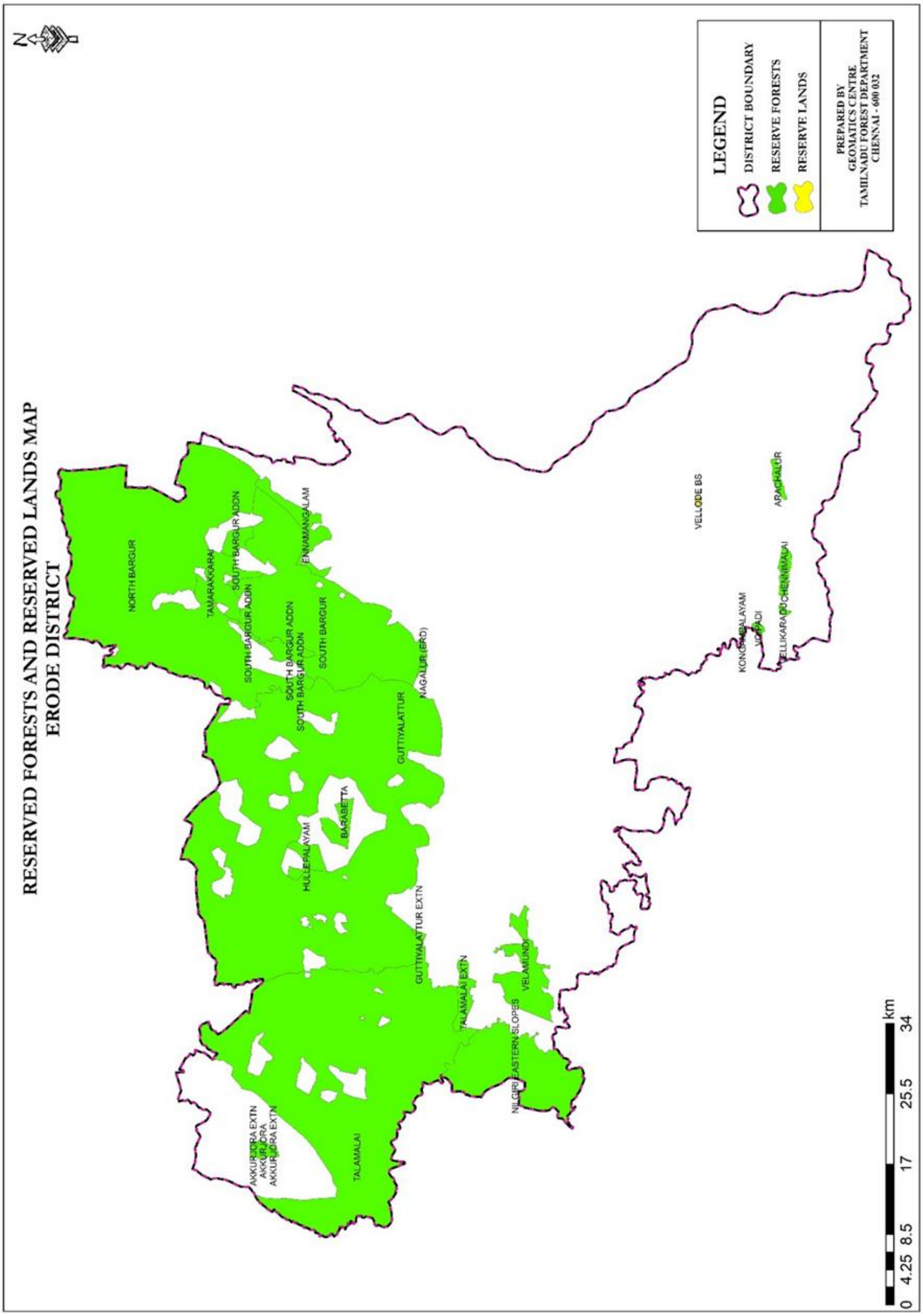


Figure 8.4.4. Map of notified forests in Erode district



5. TIRUPPUR

Though the district was created in 2009, FSI started to provide details of forest in this district only from 2017 onwards. So for the purpose of this analysis, the data of the past three ISFR reports 2017 to 2021 is only considered. There are three density classes of forests – very dense forest and moderately dense forest category is showing a similar trend of marginal decrease in the area since 2021, while the open forest category has recorded a steady increase. This indicates that the existing moderate and very dense forest category is facing some issues that has resulted in the reduction in the canopy density which has contributed to the deterioration in the quality of forest and converting it into open forest category.

However, the total forest cover area of this district has been increasing which also indicates that measures were taken to increase the tree cover. More focussed approach would help to maintain the extend of the very dense and moderately dense forest category as this district is a part of Anamalai Tiger Reserve which is a critical wildlife habitat for tigers, elephants, Lion tailed macaque, Nilgiri langur, Nilgiri tahr etc., so the habitat richness is crucial for effective wildlife management as well.

Table 8.5.1: Tiruppur Forest density classes distribution over the years

Unit in sq.km

Parameters	2017	2019	2021
TGA	5187	5187	5187
VDF	50	48.28	48.28
MDF	246	237.68	237.66
OF	509	558.47	560.25
TFCA	805	844.43	846.19
Percent	15.52	16.28	16.31
Change	34	39.43	1.76
Scrub	8	8.78	8.81

Figure 8.5.1. Trend analysis of forest in Tiruppur district

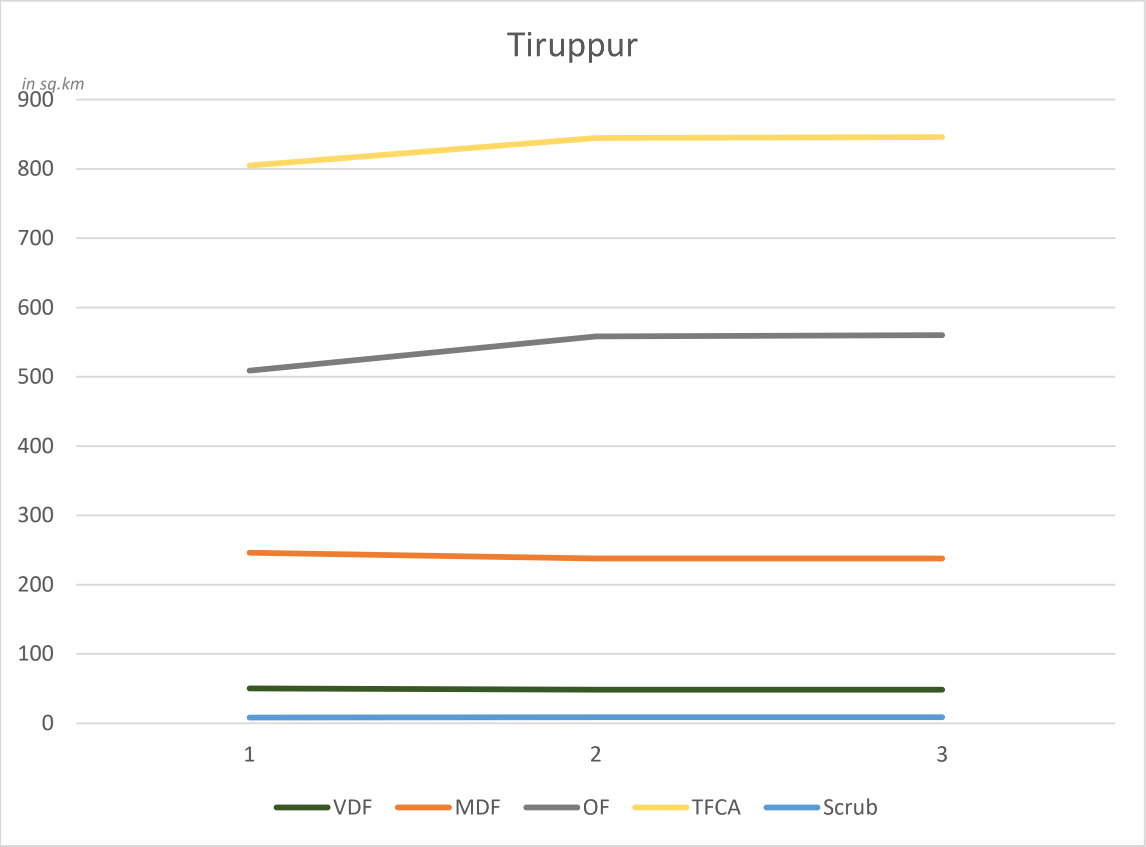


Figure 8.5.2. Share Forest & non-forest land in Tiruppur district (2021)

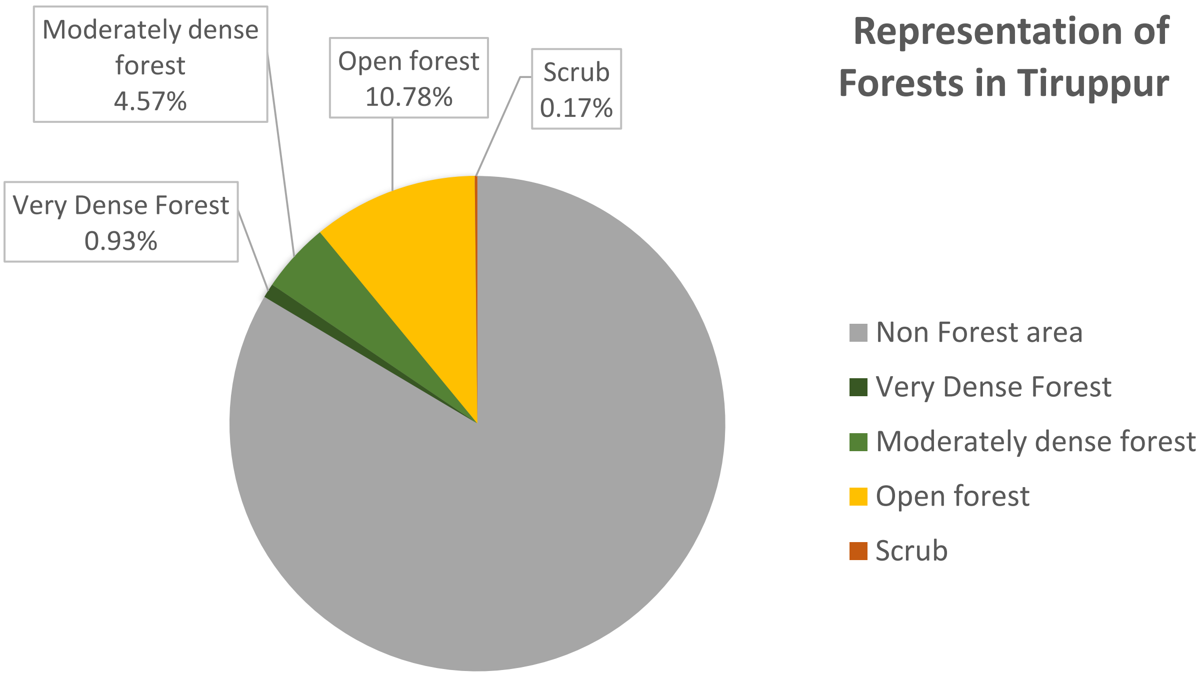


Figure 8.5.3. Forest Cover map of Tiruppur district

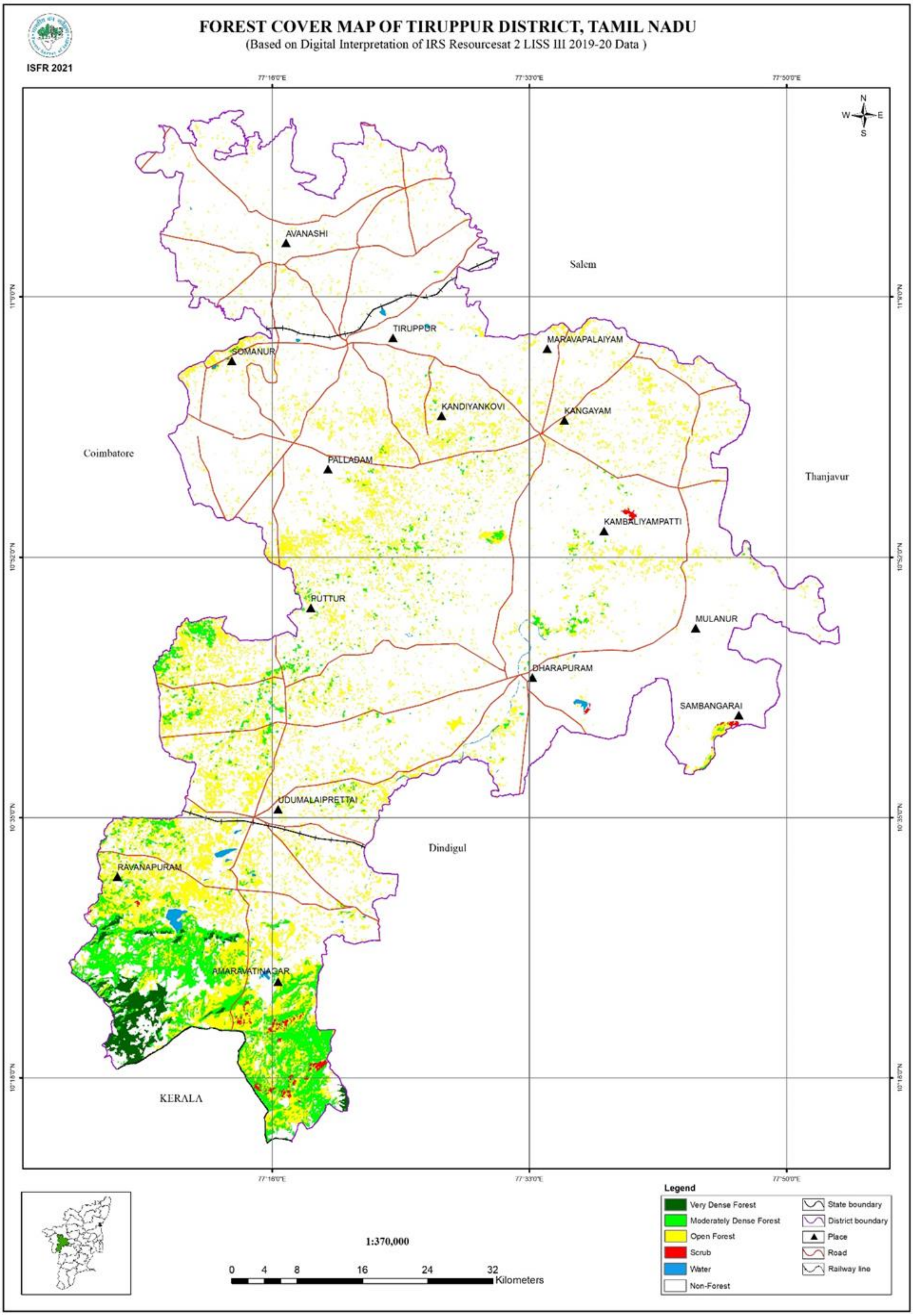
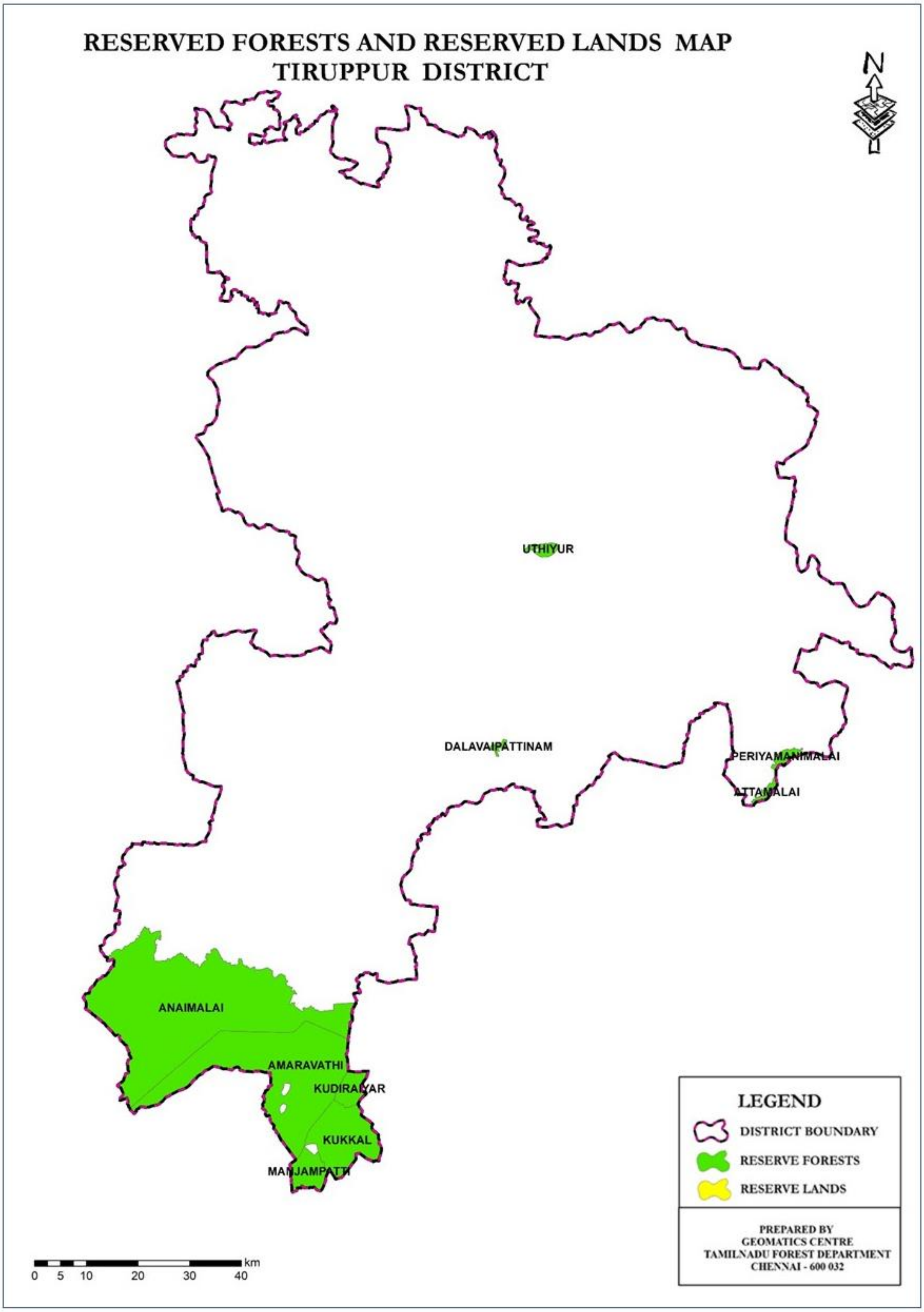


Figure 8.5.4. Map of notified forests in Tiruppur district



6. CUDDALORE

Being a coastal district and predominant activity being agriculture, Cuddalore has more opportunity for agro-forestry. In terms of recorded forest area, Cuddalore has 99.5039 sq.kms of forests with 19 reserved forests and 1 reserved land contributing 96.61 sq.kms to the recorded forest area. The district has been showing decreasing trend in the total forest cover.

From the trend map, one can clearly understand that this is due to the decrease in moderately dense forest category. The effect of cyclones or change in the land use from agro-forestry to other activities could be a possible reason for this decreasing trend. It can be inferred that the decline in the MDF category overlaps with slight increase in the open forest category which indicates that the quality of the forest cover i.e the canopy density has changed drastically during the period 2013 to 2017. So special focus on agroforestry through extension and outreach activities has to be taken up.

Table 8.6.1: Cuddalore Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	3706	3706	3706	3706	3706	3706	3703	3703	3703
VDF	0	0	0	0	0	0	0	0	0
MDF	185	179	219	218	209	79	48	47.86	47.56
OF	248	247	225	222	225	338	334	343.1	342.68
TFCA	**433**	**426**	**444**	**440**	**434**	**417**	**382**	**390.96**	**390.24**
Percent	11.68	11.49	11.98	11.87	11.71	11.25	10.32	10.56	10.54
Change	35	-2	-2	-2	-6	-17	-34	8.96	-0.72
Scrub	8.5	7	10	10	11	2	18	17.71	17.52

Figure 8.6.1. Line graph of Cuddalore forest cover distribution over the years

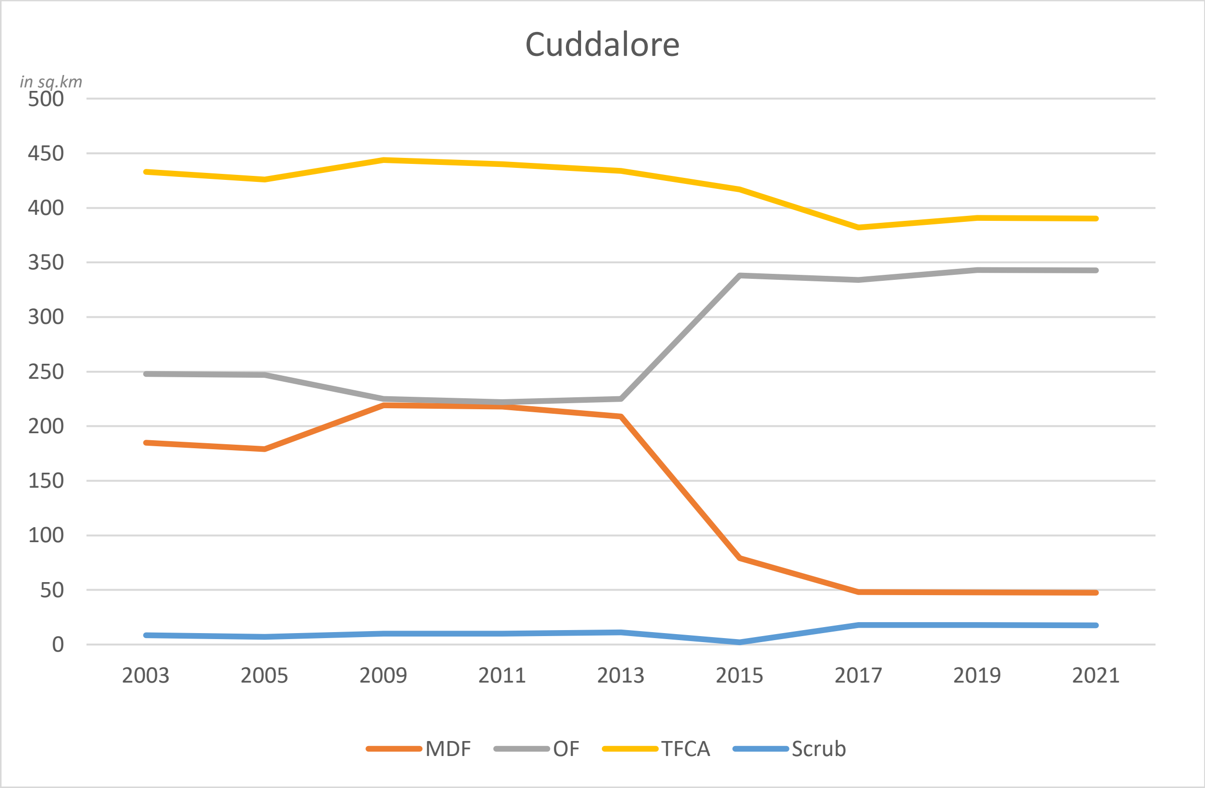


Figure 8.6.2. Pie chart of Cuddalore forest cover in 2021

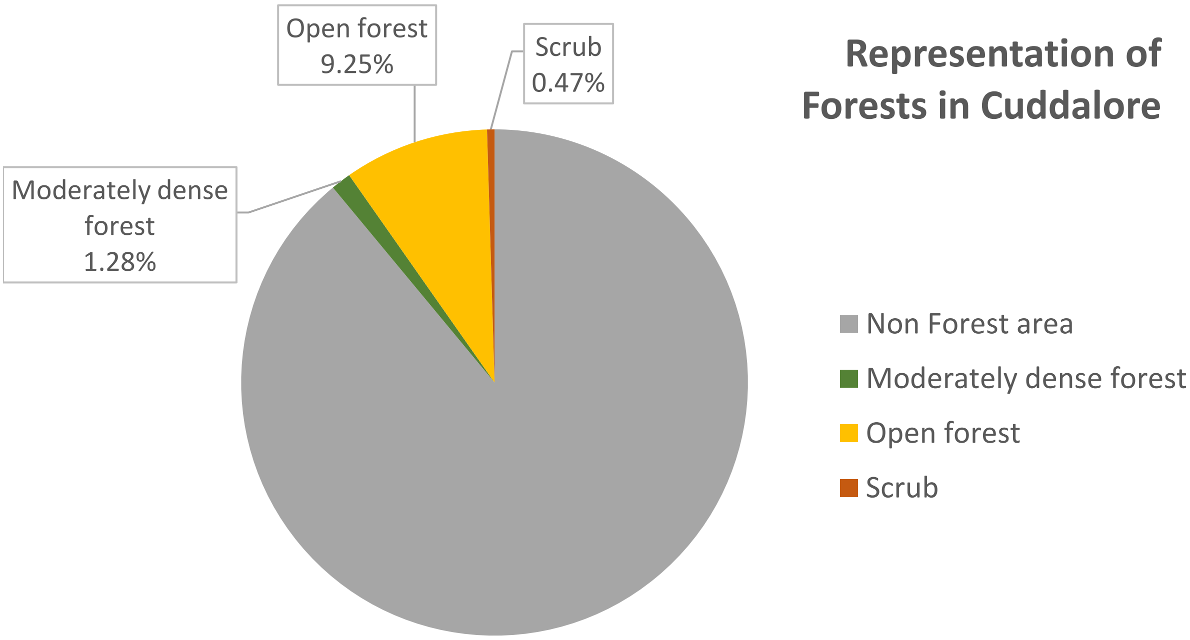


Figure 8.6.3. Forest Cover map of Cuddalore District

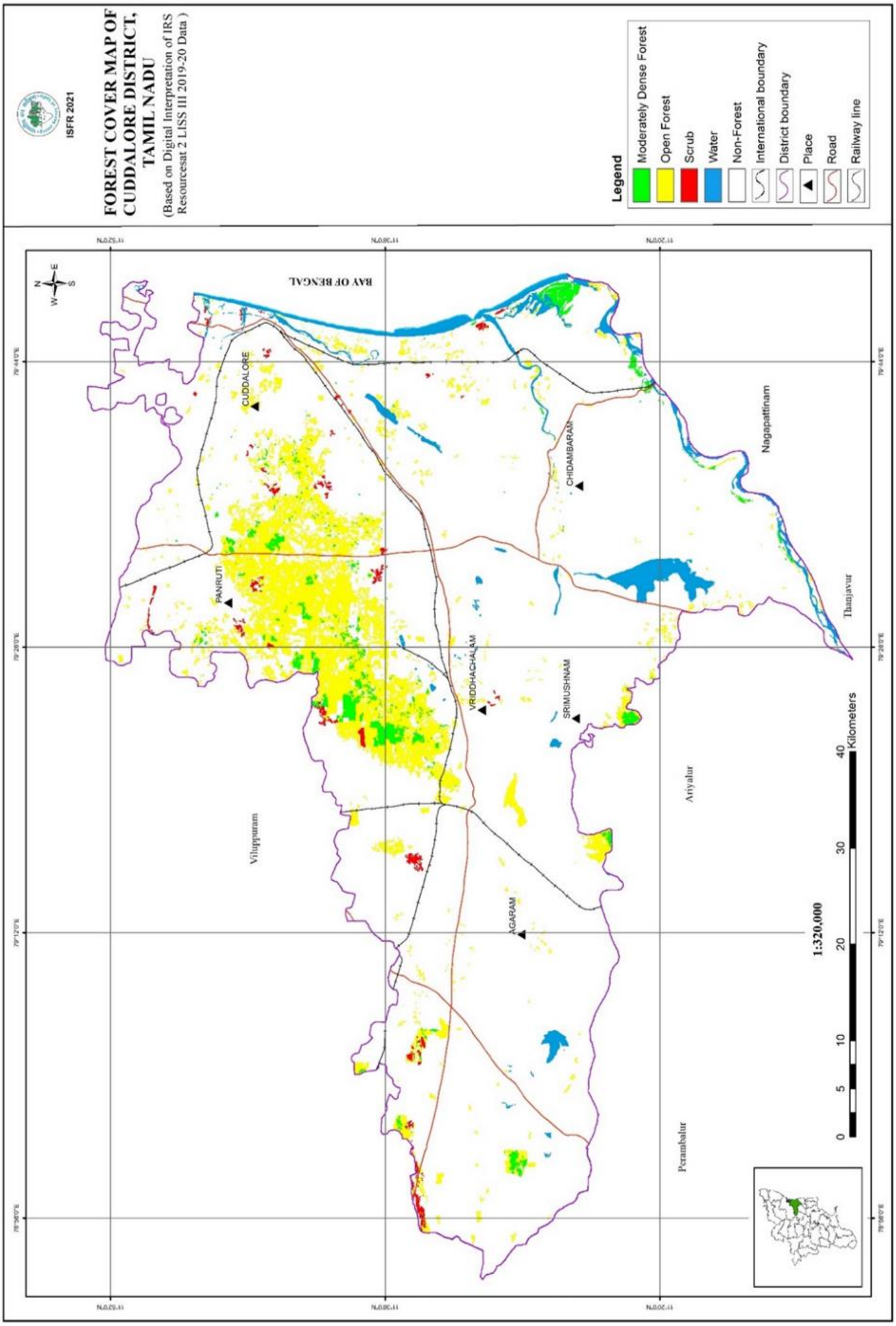
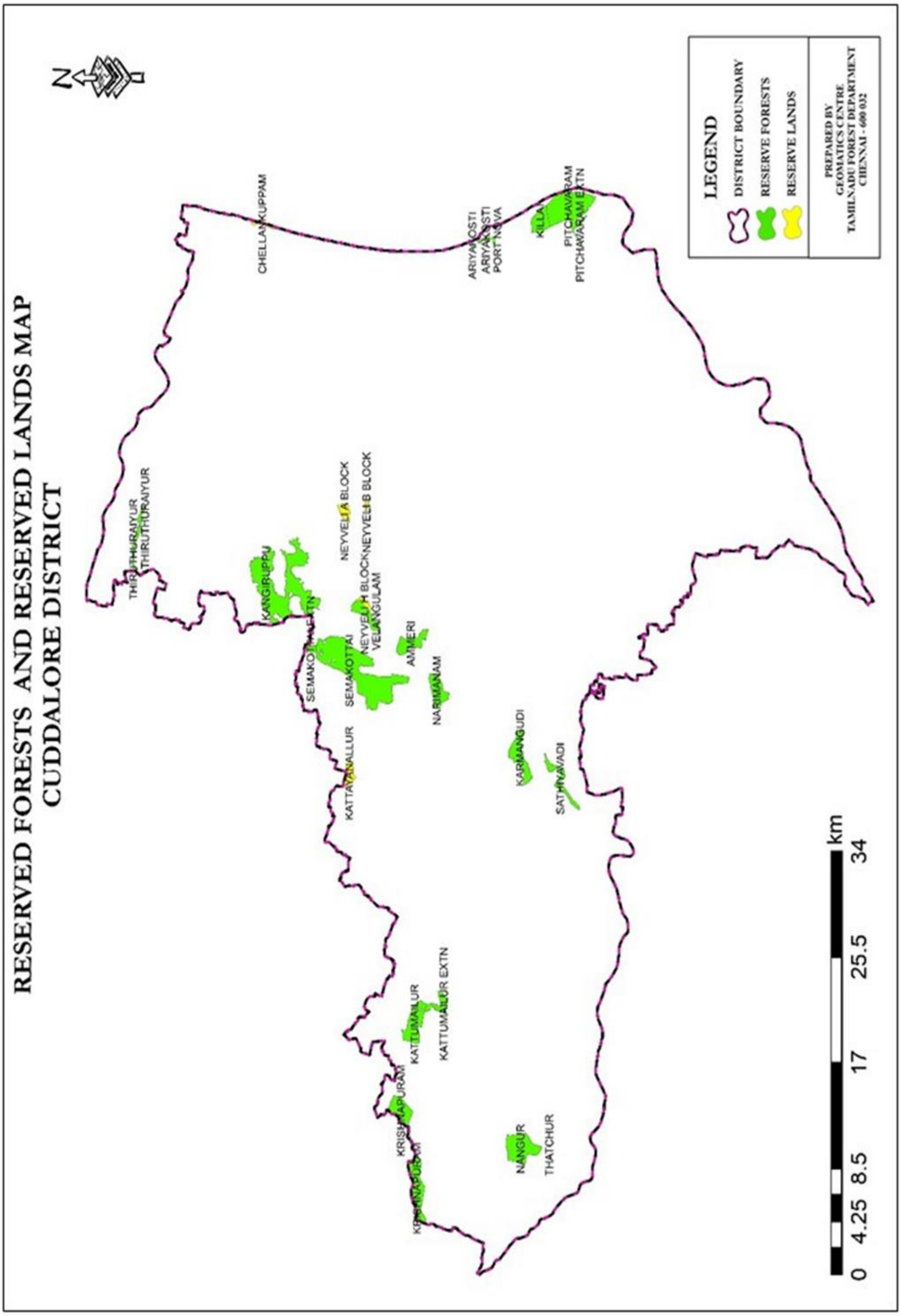


Figure 8.6.4. Map of Notified Forests in Cuddalore district



7. DHARMAPURI

The combined Dharmapuri district includes the present Dharmapuri and Krishnagiri district. The later was carved out of the former in 2004, but FSI considered the combined area for the ISFR reports until 2015.

The total recorded forest area in Dharmapuri as on 2021 is 1654.98 sq.km. The district has 136 reserved forests and 18 reserved lands which occupies about 1652.35 sq.km. The district has close to 37% of the geographical area as forest cover. There are three density classes of forest here – very dense, moderately dense, and open forests. Moderately dense forest and open forest contribute more to the share of the forest cover here. Though the trend in the values show a sharp decline in forest cover that is attributed to the bifurcation of the district. With respect to the very dense forest and moderately dense forest – there is a marginal decline in the area since 2017 which needs a closer watch and more attention.

Table 8.7.1: Dharmapuri Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	9622	9622	9622	9622	9622	9622	4497	4497	4497
VDF	193	193	239	241	255	271	271	261.85	261.85
MDF	1051	1052	1080	1078	1053	1436	842	835.79	835.75
OF	1710	1710	1708	1715	1720	1573	585	603.5	605.11
TFCA	2954	2955	3027	3034	3028	3280	1698	1701.14	1702.71
Percent	30.7	30.71	31.46	31.53	31.47	34.09	37.76	37.83	37.86
Change	259	5	0	7	-6	252	16	3.14	1.57
Scrub	162	227	201	201	199	28	13	14.31	15.06

Figure 8.7.1. Trend analysis of forest in Dharmapuri district

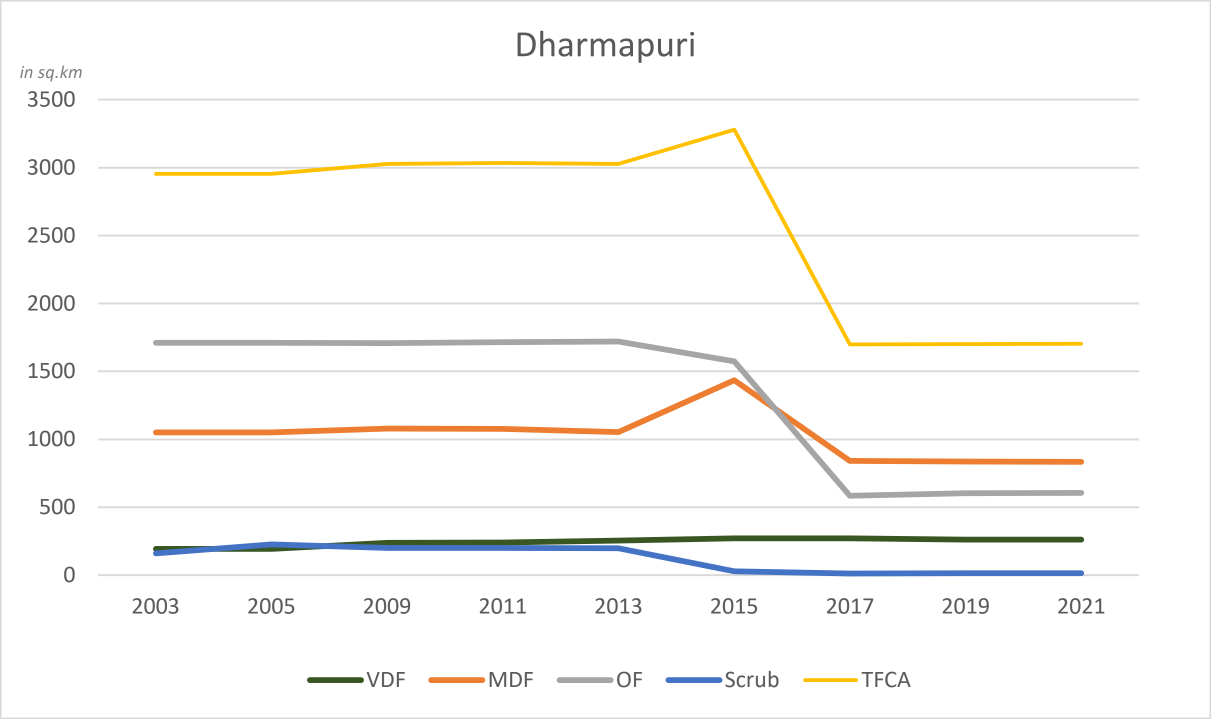


Figure 8.7.2. Share of Forest & non-forest area in Dharmapuri districts (2021)

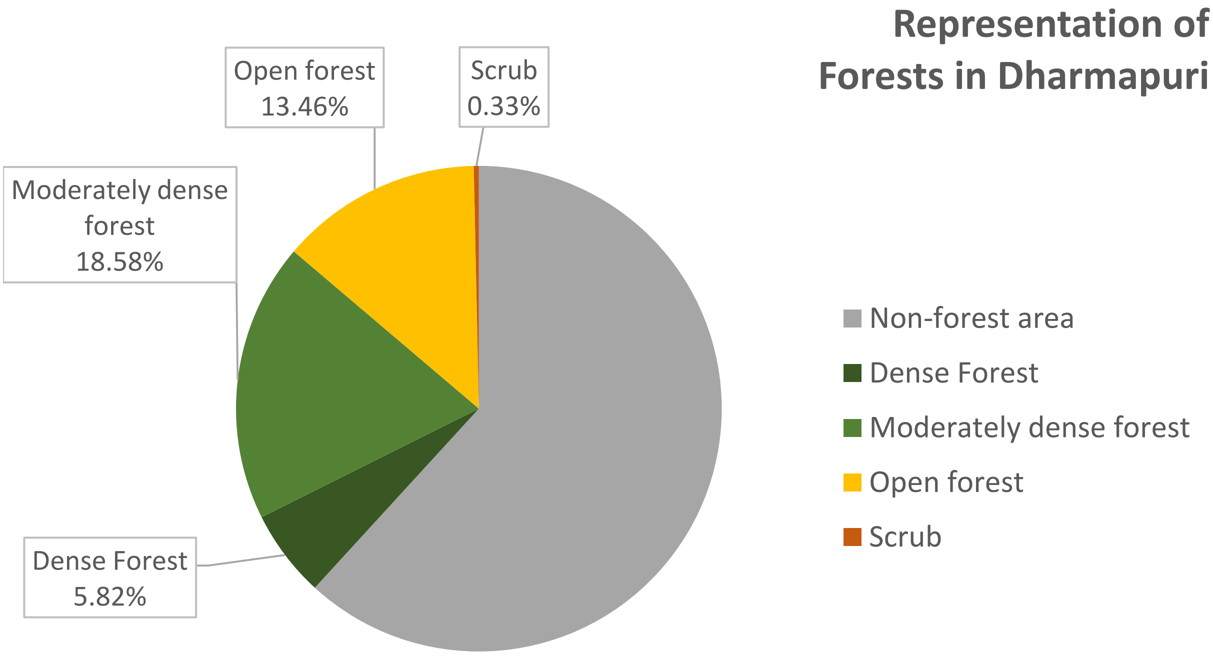


Figure 8.7.3. Forest Cover map of Dharmapuri district

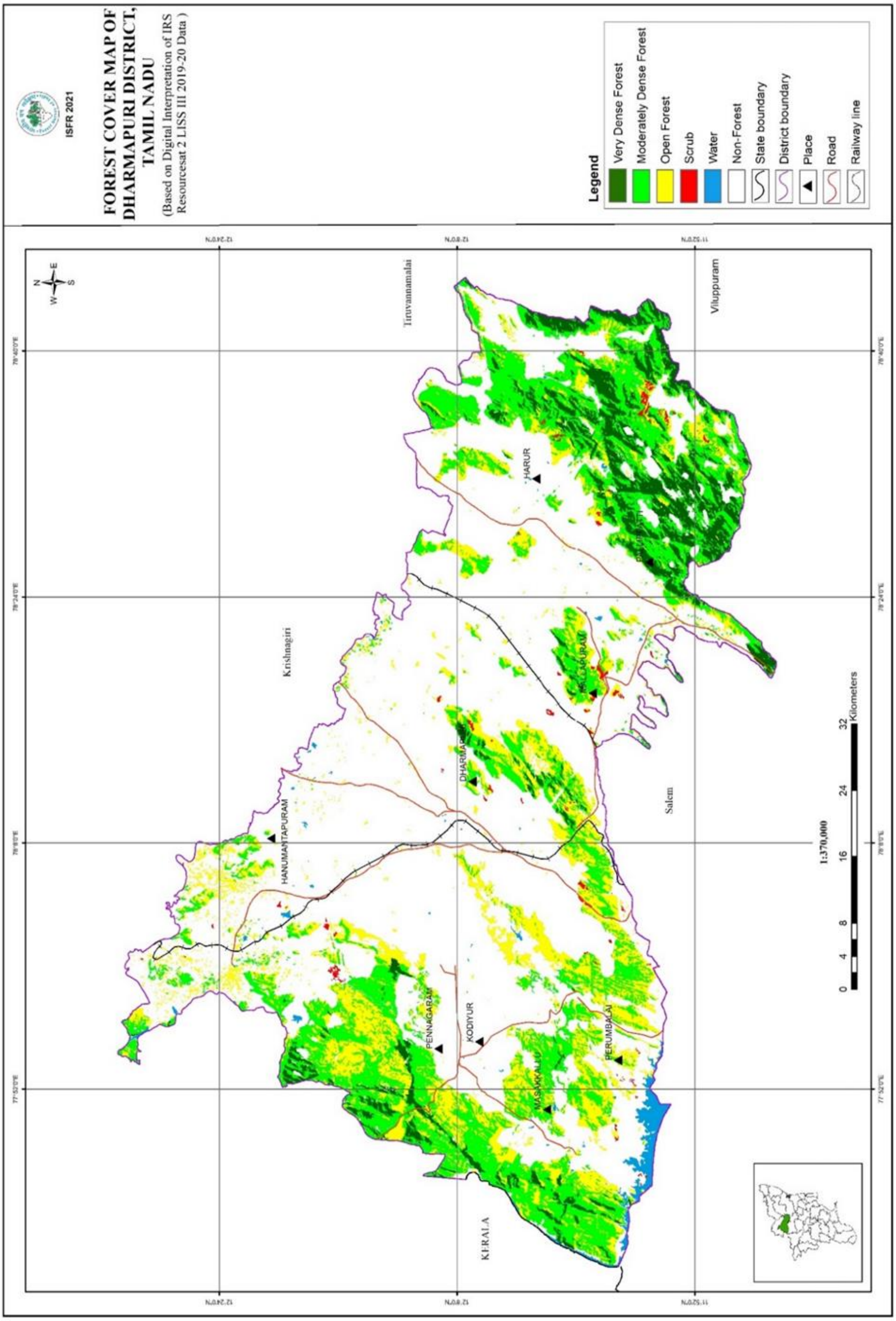
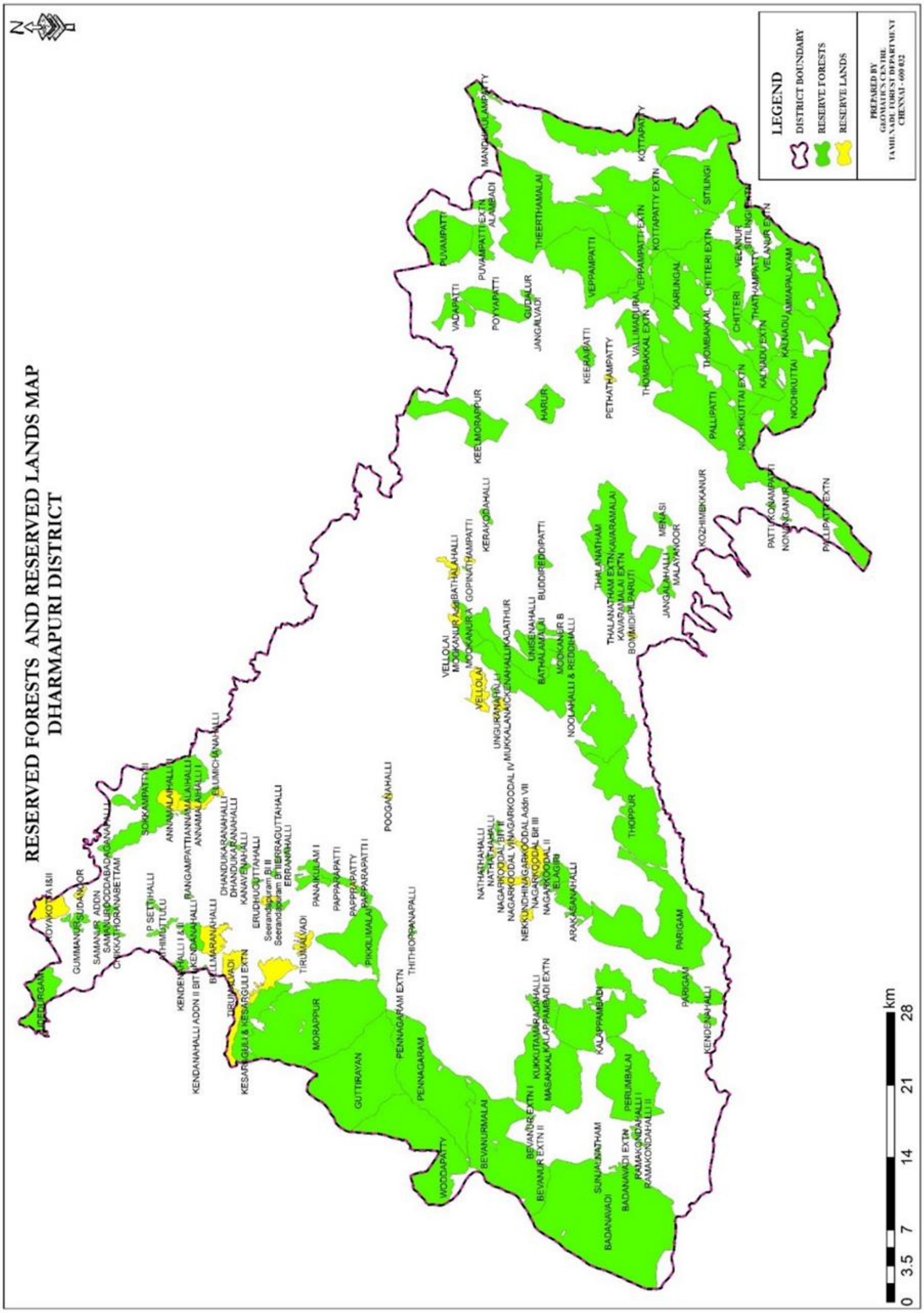


Figure 8.7.4. Map of notified forests in Dharmapuri district



8. KRISHNAGIRI

Though Krishnagiri was created in 2004, FSI started to give forest cover data for this district only from 2017. As per forest records (2021), Krishnagiri district has 121 reserved forests and 33 reserved land which contributes about 1490 sq.km of forests. The total forest cover of this district is 31.55% of its geographical area. All three classes of forest are found here with very Dense Forest class occupying 1.84%, moderately dense forest occupying 16% and open forest in 13.47% of the area. The total forest cover area has increased since 2017.

The below table indicates that there has been a considerable decline in the moderately dense forest while the open forest has increased parallelly. This clearly indicates that the degradation in the canopy density which has led to the change in the moderately dense class to the open forest class. About 32.76 sq.km. area is occupied by scrub indicating the possibility of increasing its green cover and canopy density through specialised schemes.

Table 8.8.1: Krishnagiri Forest density classes distribution over the years

Unit in sq.km

Parameters	2017	2019	2021
TGA	5129	5129	5129
VDF	95	94.87	94.87
MDF	843	827.67	827.61
OF	611	694.87	695.47
TFCA	1549	1617.41	1617.95
Percent	30.2	31.53	31.55
Change	-38	68.41	0.54
Scrub	24	31.38	32.76

Figure 8.8.1. Trend analysis of forest in Krishnagiri district

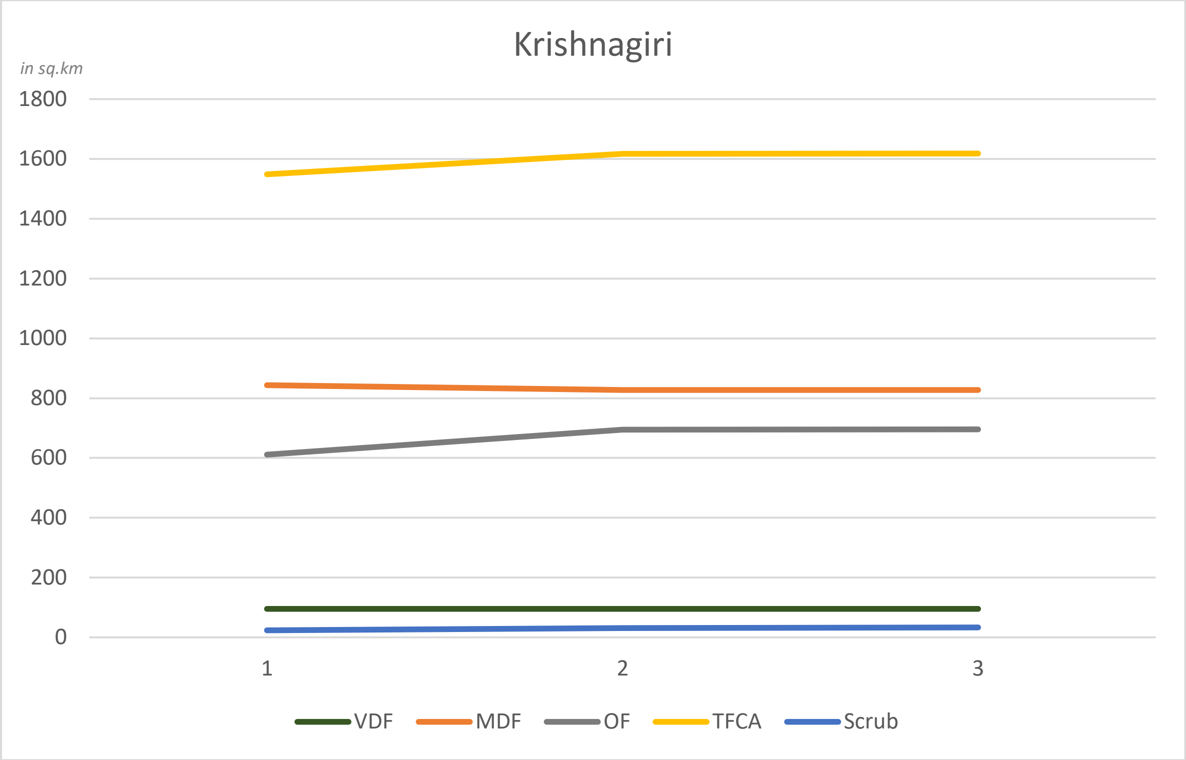


Figure 8.8.2. Share of Forest & non-forest area in Krishnagiri district (2021)

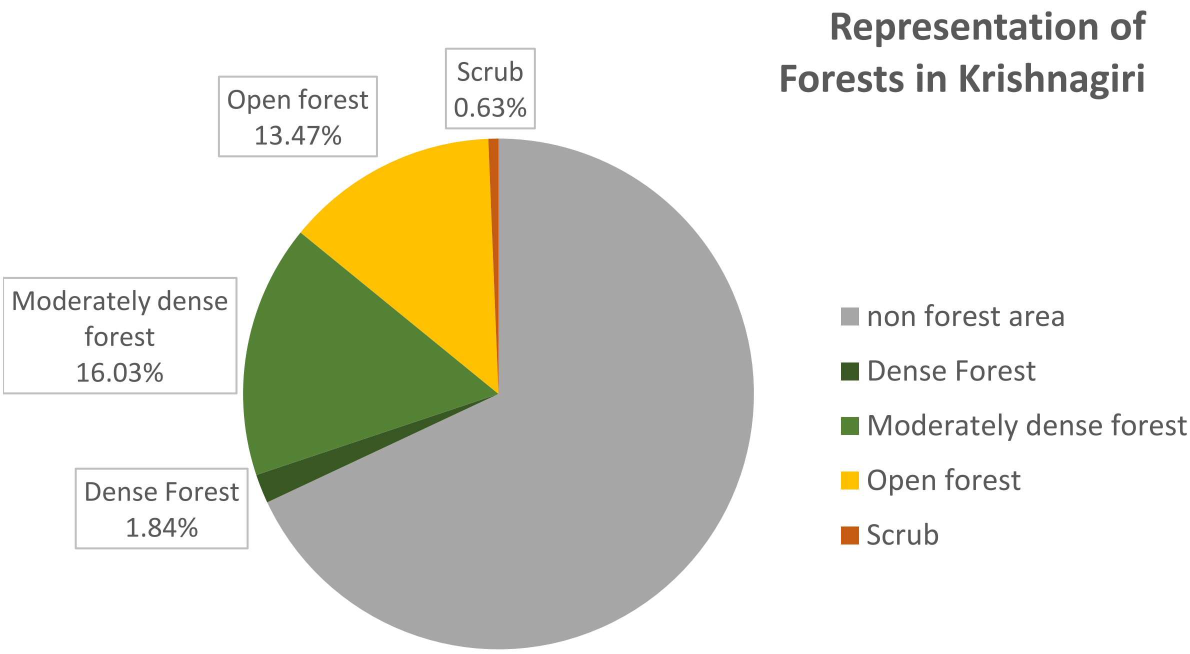


Figure 8.8.3. Forest Cover map of Krishnagiri district

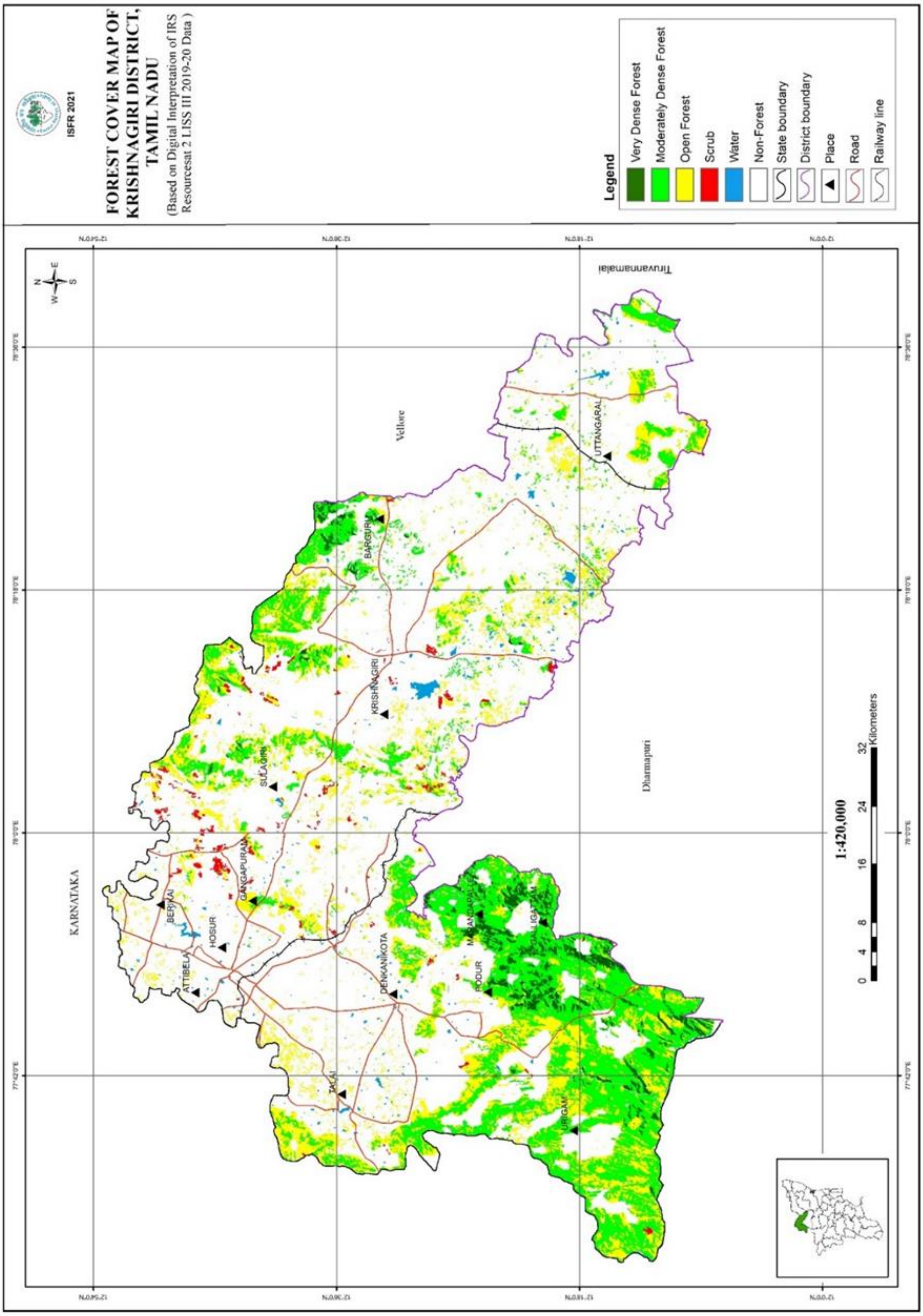
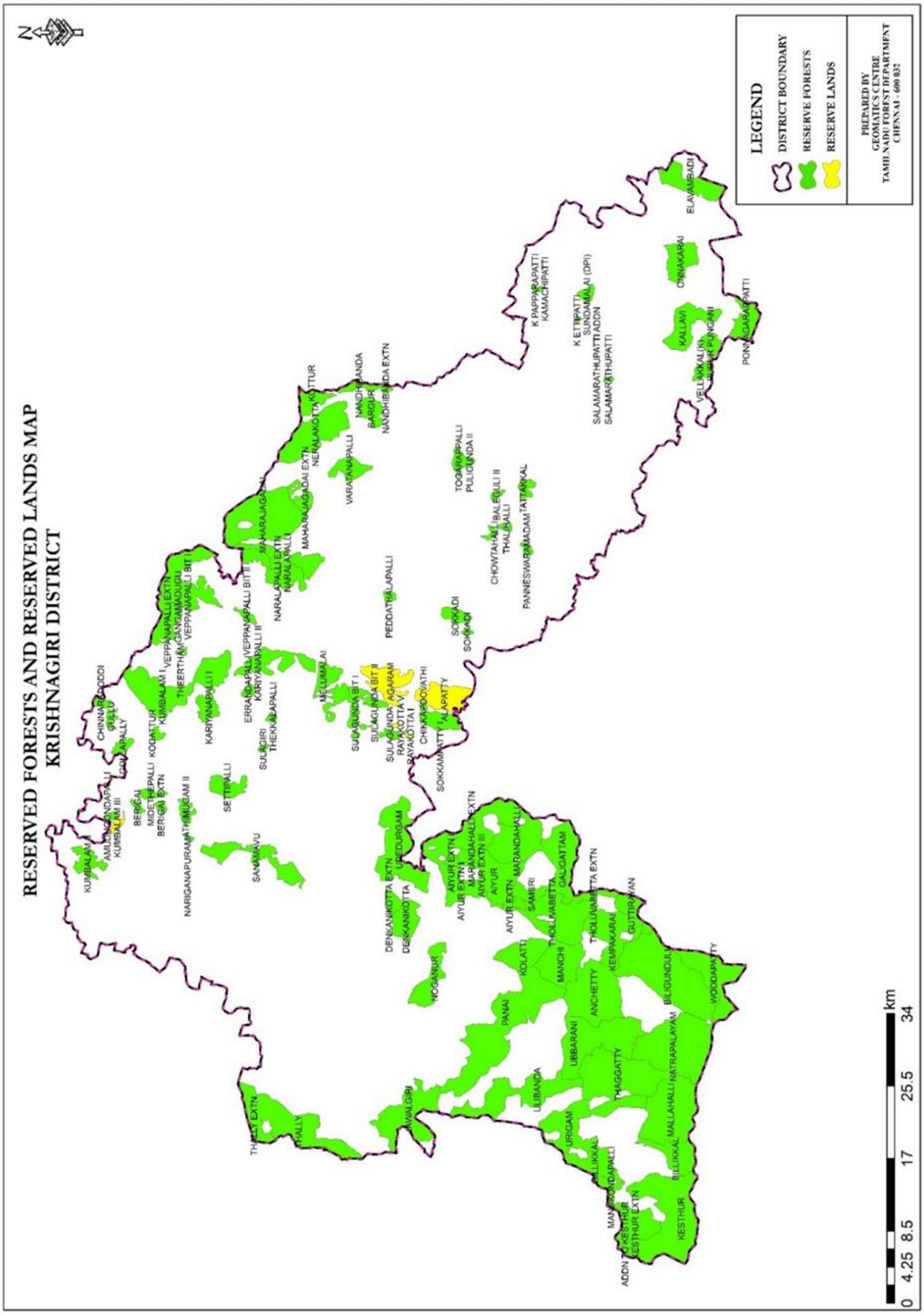


Figure 8.8.4. Map of notified forests in Krishnagiri district



9. DINDIGUL

Dindigul has a total forest cover area of 1877 square kilometres. As per ISFR 2021, this district is the third highest in terms of forest cover area, next to Coimbatore. The total geographical area (TGA) of this district is 6036 sq.km. In TGA, around 31% contributes to forest cover. Since 2003, very dense forest category has been expanding; it reached 354 sq. km in 2013, after which it gradually decreased to 252 square kilometres in 2021. By 2021, the moderate forest category had gained 245.12 square kilometres, despite some reductions between 2003 and 2009.

A steep fall in the open forest class occurred in 2005; however, it has gradually increased throughout the following 18 years by gaining 302.86 sq.km area. The total increment in all three density classes has contributed to the increase in the total forest cover area of Dindigul. The overall report shows that Dindigul has almost one third of forest land even though the very dense forest area has decreased largely. Invasive alien species are one of the major threats to the dense forest class especially in Kodaikanal hills. Therefore, effective management of forest fires and invasive species through a well laid out strategy can help in the improvement of the forest quality.

Table 8.9.1: Dindigul Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	5580	5580	5580	5580	5580	5580	6036	6036	6036
VDF	63	249	352	351	354	307	256	253.19	251.99
MDF	662	620	537	551	559	643	771	779.85	782.12
OF	541	396	540	587	613	712	849	841.36	843.86
TFCA	1266	1265	1429	1489	1526	1662	1876	1874.4	1877.97
Percent	22.69	22.67	25.61	26.68	27.35	29.78	31.08	31.05	31.11
Change	98	0	0	43	37	136	6	-1.6	3.57
Scrub	94.5	150	64	60	56	7	34	30.83	31.9

Figure 8.9.1. Trend analysis of Forest in Dindigul district

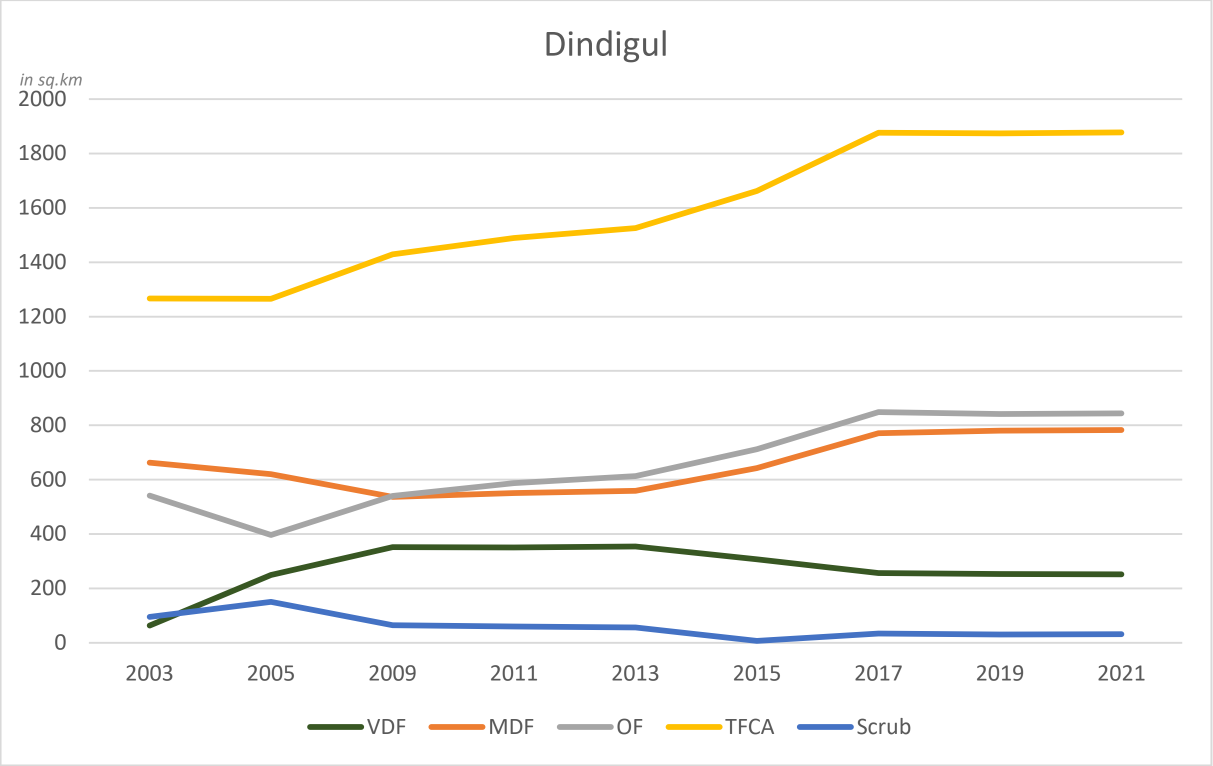


Figure 8.9.2. Share of Forest & non-forest area in Dindigul district (2021)

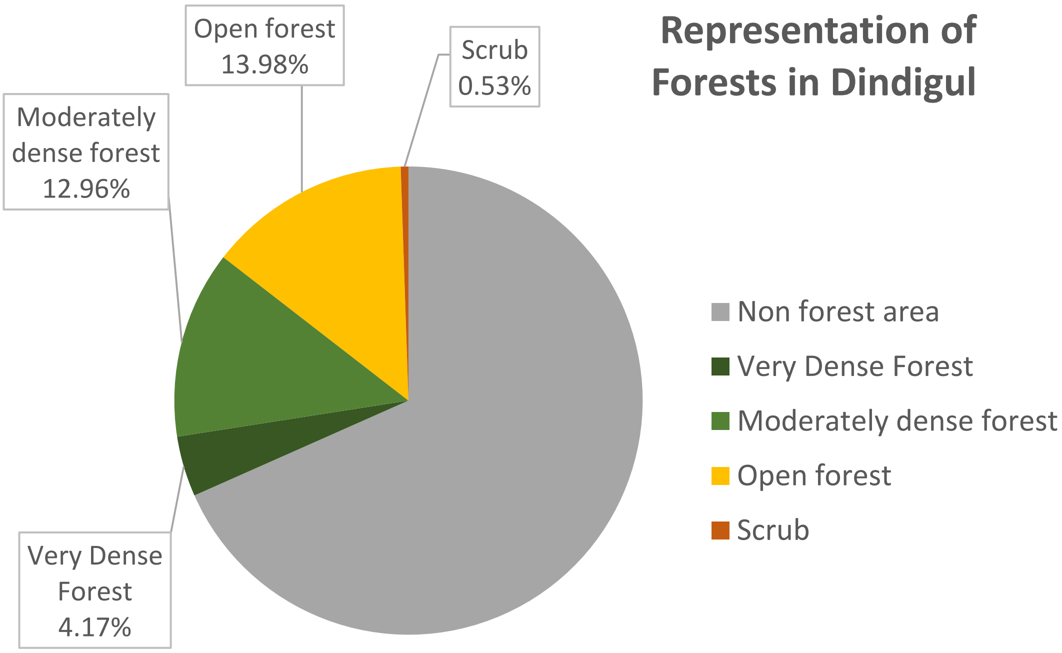


Figure 8.9.3. Forest Cover map of Dindigul district

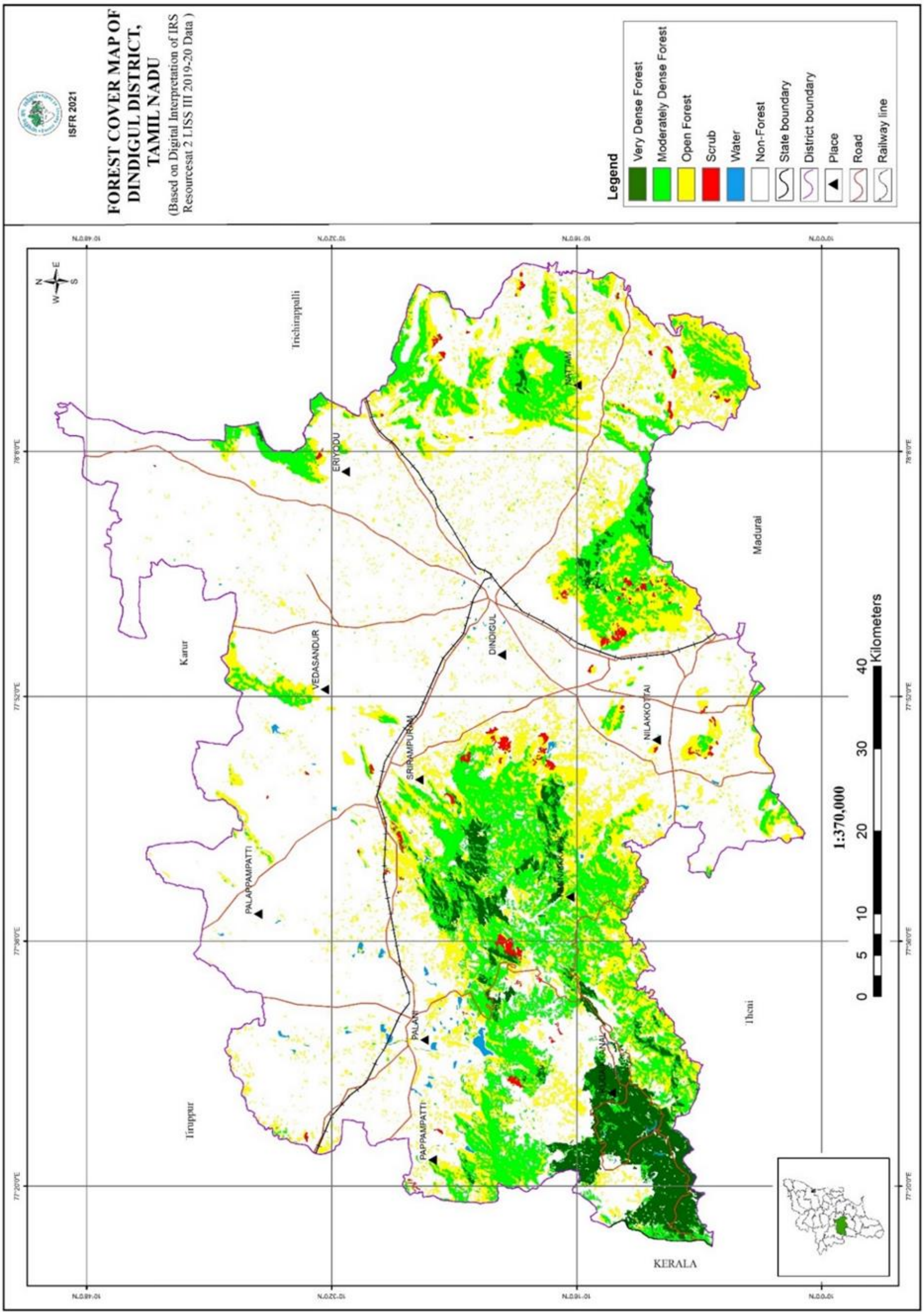
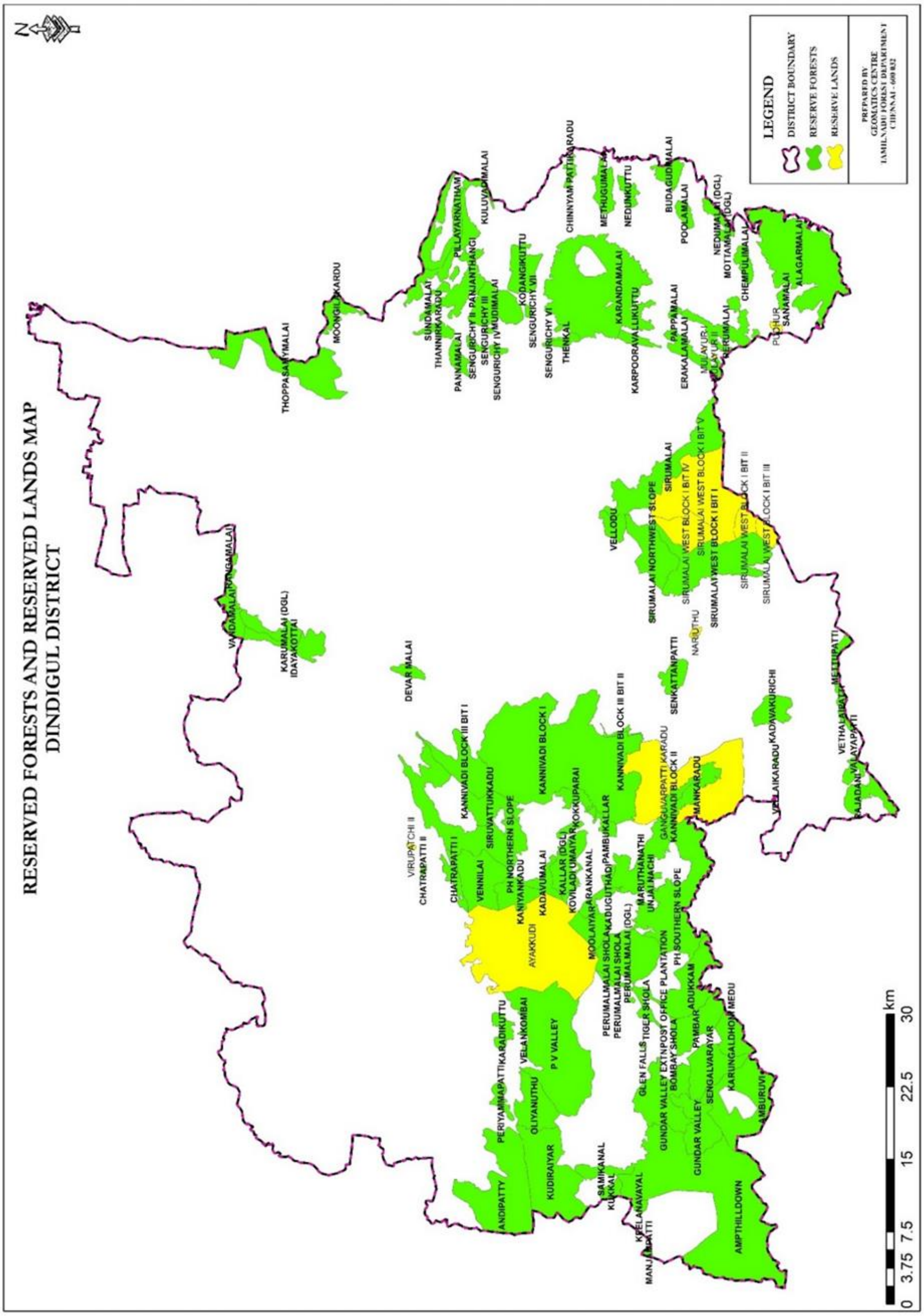


Figure 8.9.4. Map of notified forests in Dindigul district



10. KANCHEEPURAM

The total geographical area of Kancheepuram district is 4483 sq.km. The district's forest cover accounts for 8% of the TGA. Very dense forest category is absent here. After a steady increase in the first decade (2003-2013), moderate forests began to decline until 2021. The open forest area decreased steadily from 2003 to 2015, eventually reaching 253.52 square kilometres in 2021. The total forest cover area of this district does not follow a steady trend and has been fluctuating. This indicates that the forests in this region are highly vulnerable to multiple challenges like increasing urbanisation, developmental anthropogenic pressures, drought, and climate change.

Similar trends are seen in the scrub land category which has also been subjected to multiple pressures as listed above. To increase tree cover, the departments shall focus more on the forest areas where soil moisture conservation works must be taken up to improve the soil quality and to increase the soil moisture content, which is highly essential for tree survival. There is a good scope for the Green Tamil Nadu mission to focus on tree outside forest especially in the scrub land category.

Table 8.10.1: Kancheepuram Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	4474	4474	4474	4474	4474	4474	4483	4483	4483
VDF	0	0	0	0	0	0	0	0	0
MDF	106	107	113	123	124	87	72	69.95	71.79
OF	271	272	259	253	248	209	238	237.83	253.52
TFCA	377	379	372	376	372	296	310	307.78	325.31
Percent	8.43	8.47	8.31	8.4	8.31	6.62	6.92	6.87	7.26
Change	-23	-1	3	4	-4	-76	15	-2.22	17.53
Scrub	258.5	25	24	19	18	4	34	35.75	40.29

Figure 8.10.1. Trend analysis of forest in Kancheepuram district

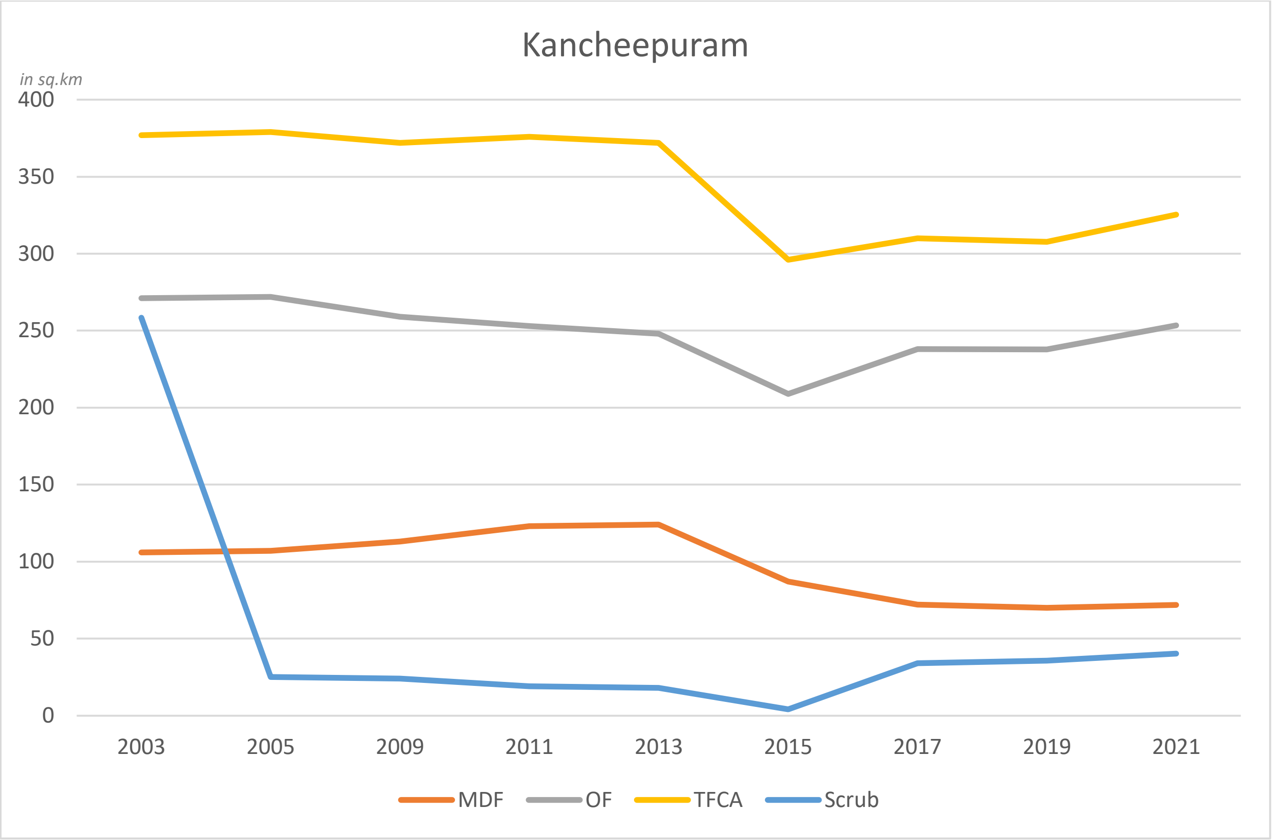


Figure 8.10.2. Share of Forest & non-forest area in Kancheepuram districts (2021)

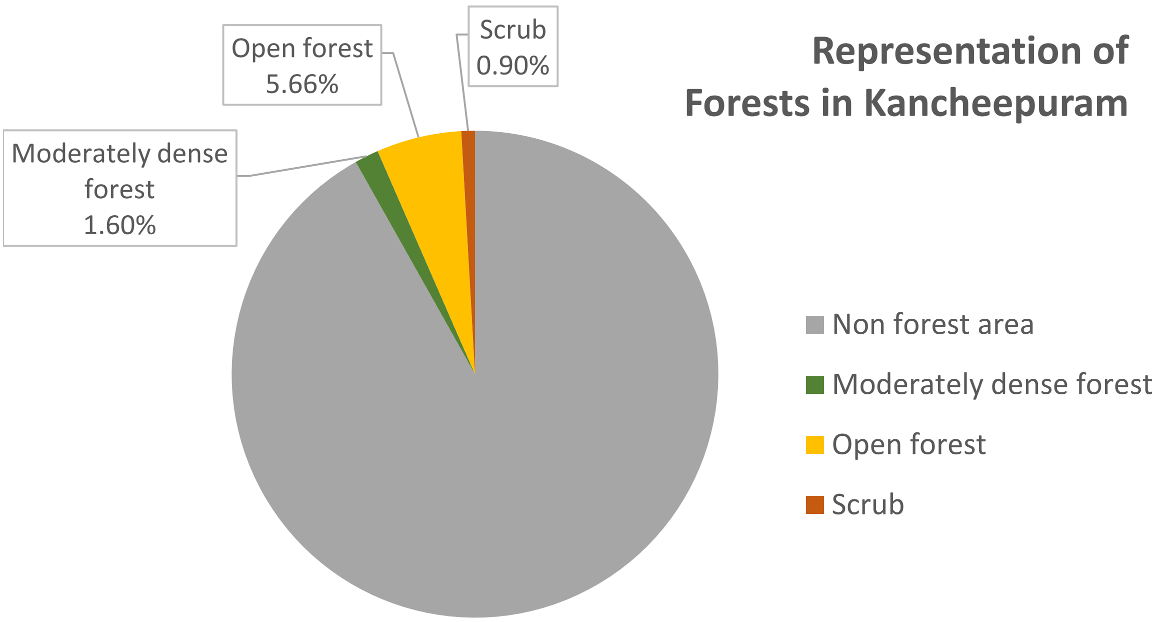


Figure 8.10.3. Forest Cover map of Kancheepuram district

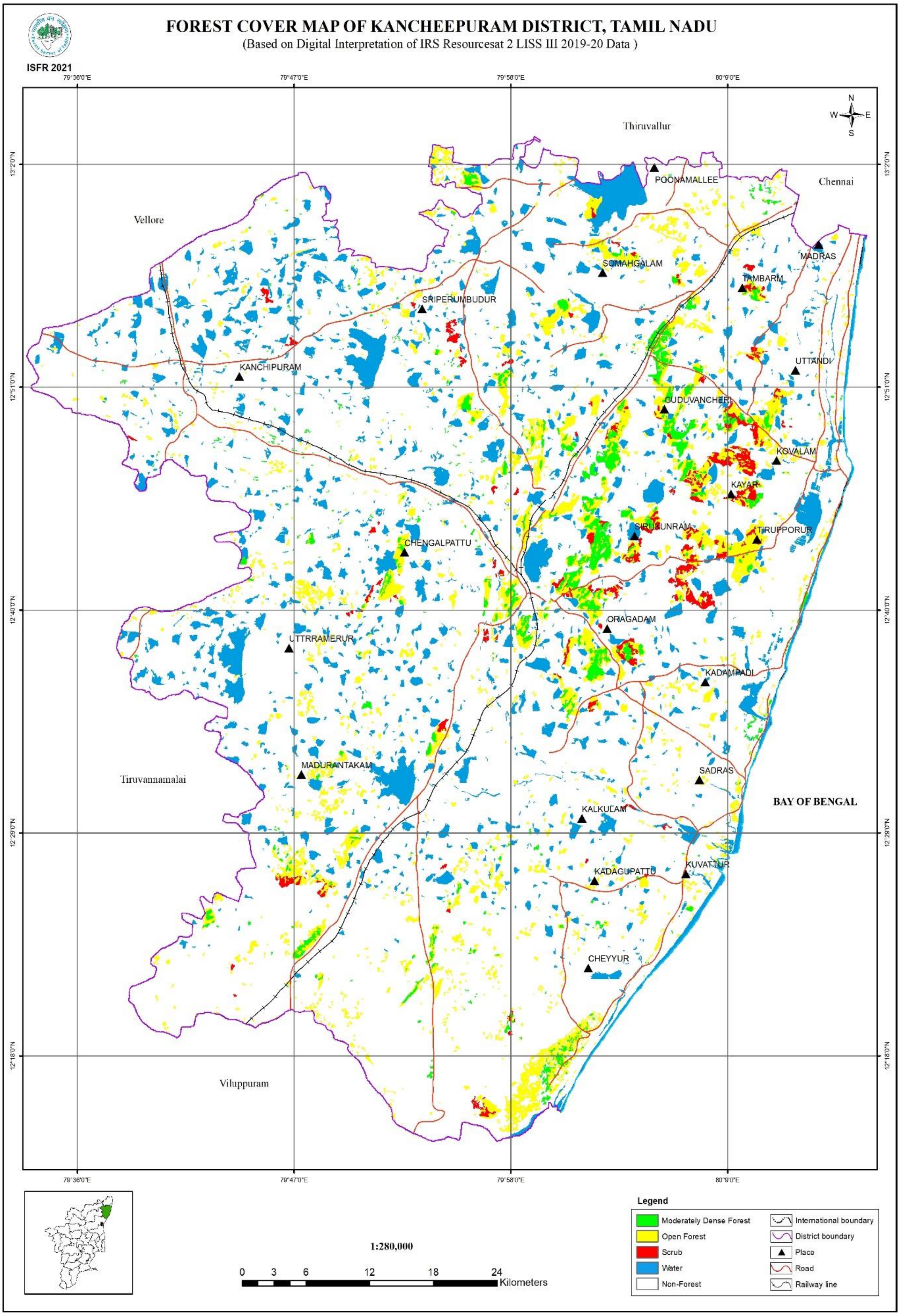
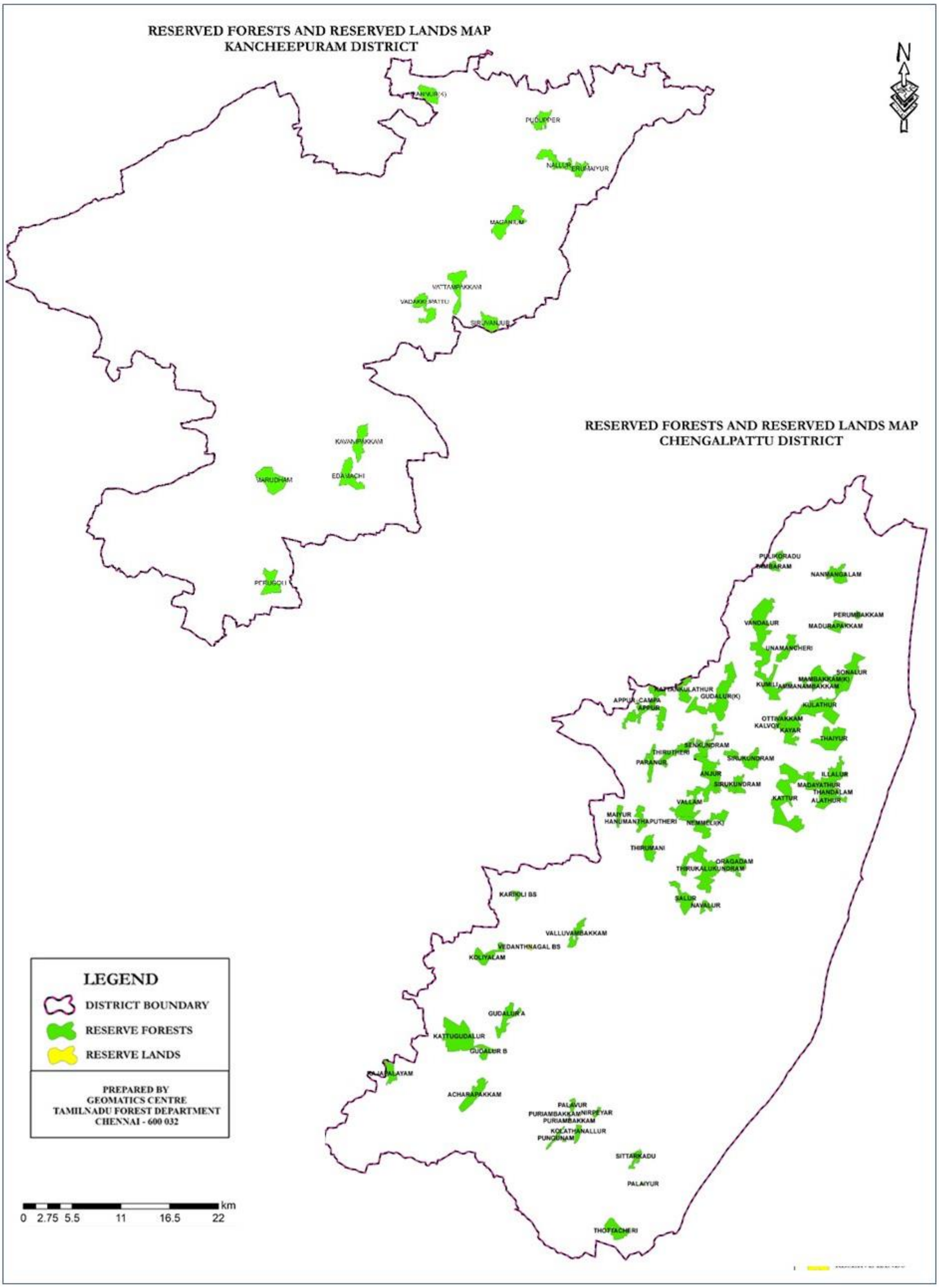


Figure 8.10.4. Map of notified forests in Kancheepuram district



11. KANYAKUMARI

Kanyakumari has a total geographical area of 1,684 sq.km. This district has 20 reserved forests with 559 sq.km area, 7 reserved lands with 41.4 sq.km area and the rest of the TFCA under unclassified lands. Kanyakumari district has recorded 59.6 % of its geographical area as forest cover as per ISFR 2021. Within eight years (2003 - 2011), the dense forest cover shrank from 78 sq.km. to 40 sq.km. Since 2013, this category of forest started improving, and in the next eight years, it has reached 136.08 sq.km. The moderate forest category has seen a steady growth since 2011.

The open forest category has seen a gradual increase from 2003 to 2009; after which it has been fluctuating largely. With respect to the Scrub land, the area has been decreasing largely and in 2021 only 0.58 sq.km. is estimated as scrub land. The reason for the loss in the scrub land has to be examined. In Kanyakumari, attention should be given to notify the large area of unclassified land as forest which will give the legal protection to these lands and would also contribute to increase its canopy density, thereby increasing the forest cover.

Table 8.11.1: Kanyakumari Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	1684	1684	1684	1684	1684	1684	1684	1684	1684
VDF	78	78	43	40	41	44	146	137.18	136.08
MDF	253	382	224	417	435	444	554	572.65	570.22
OF	204	206	212	195	271	462	294	293.71	297.3
TFCA	535	666	479	652	747	950	994	1003.54	1003.6
Percent	31.77	39.55	28.44	38.72	44.36	56.41	59.03	59.59	59.6
Change	30	0	0	0	95	203	-13	9.54	0.06
Scrub	46.5	63	34	31	33	5	1	0.58	0.58

Figure 8.11.1. Trend analysis of forest in Kanyakumari

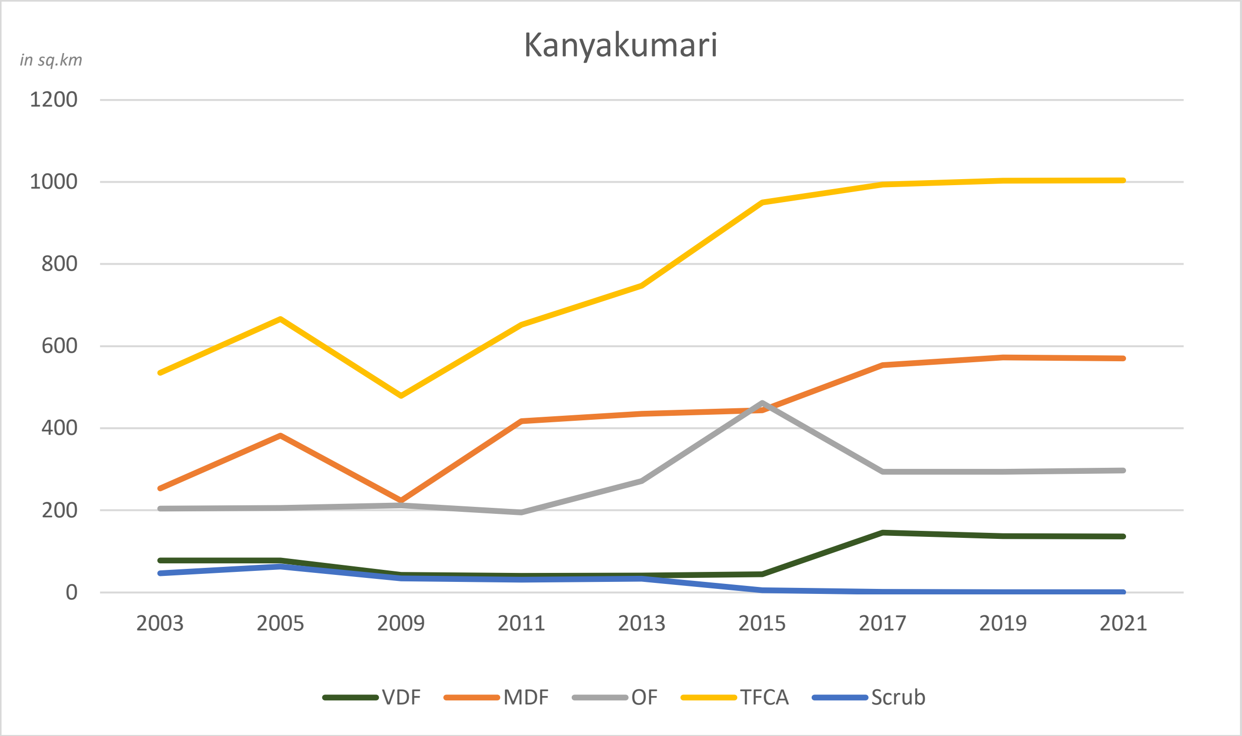


Figure 8.11.2. Share of Forest & non-forest area in Kanyakumari district (2021)

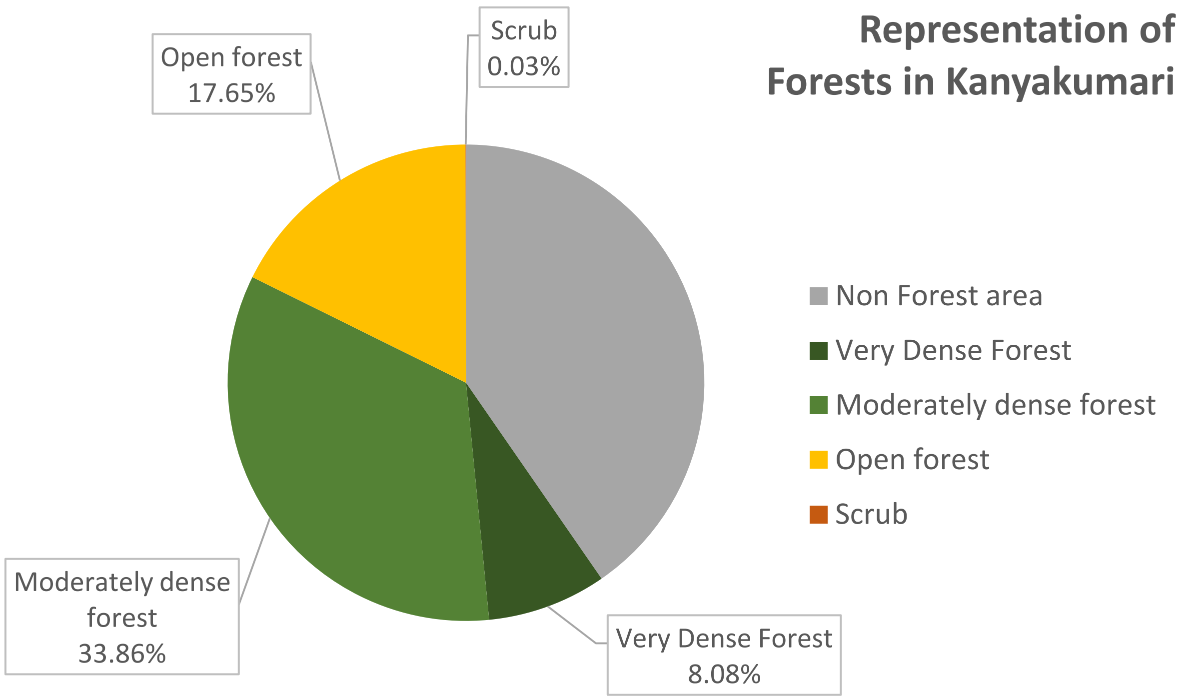


Figure 8.11.3. Forest Cover map of Kanyakumari district

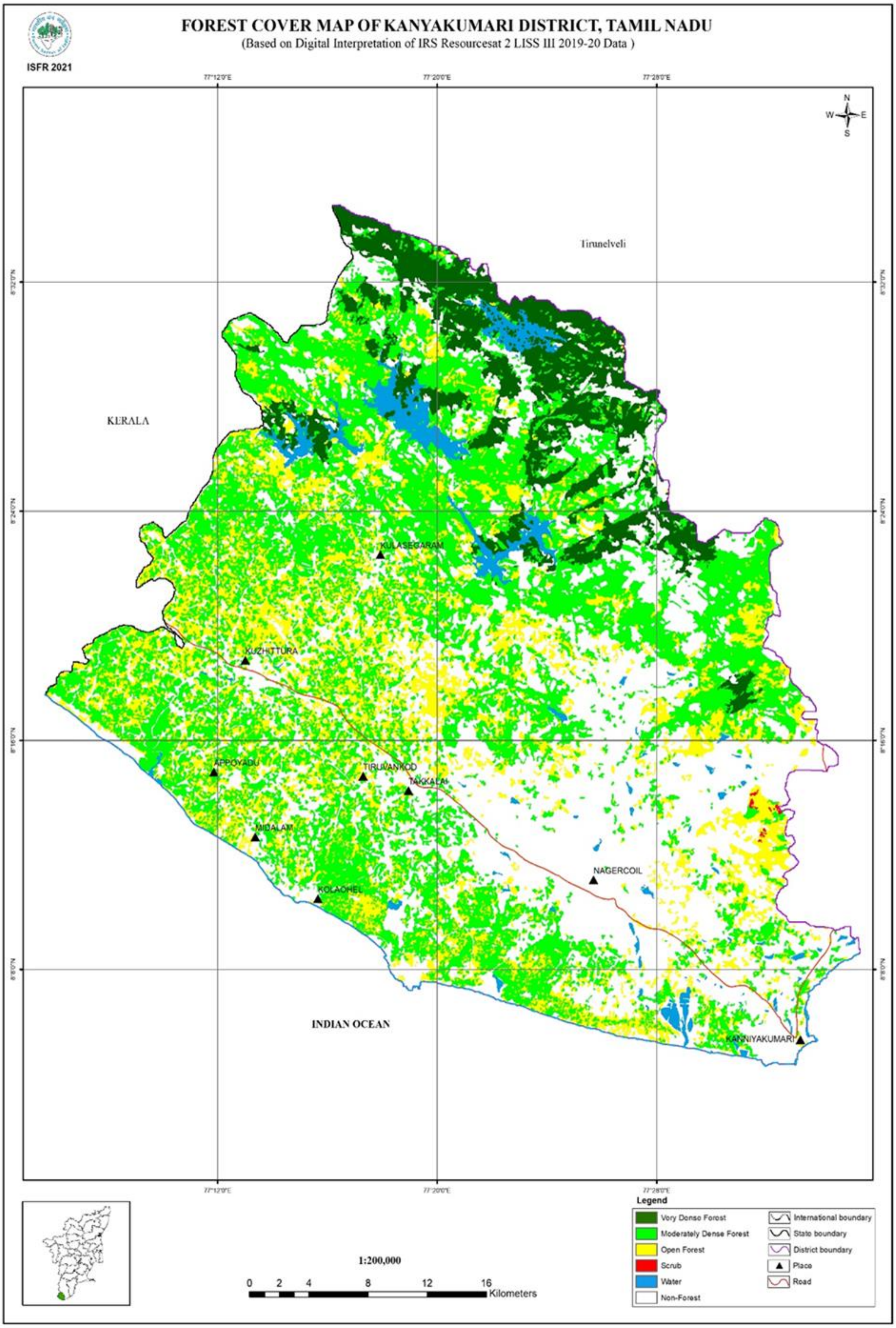
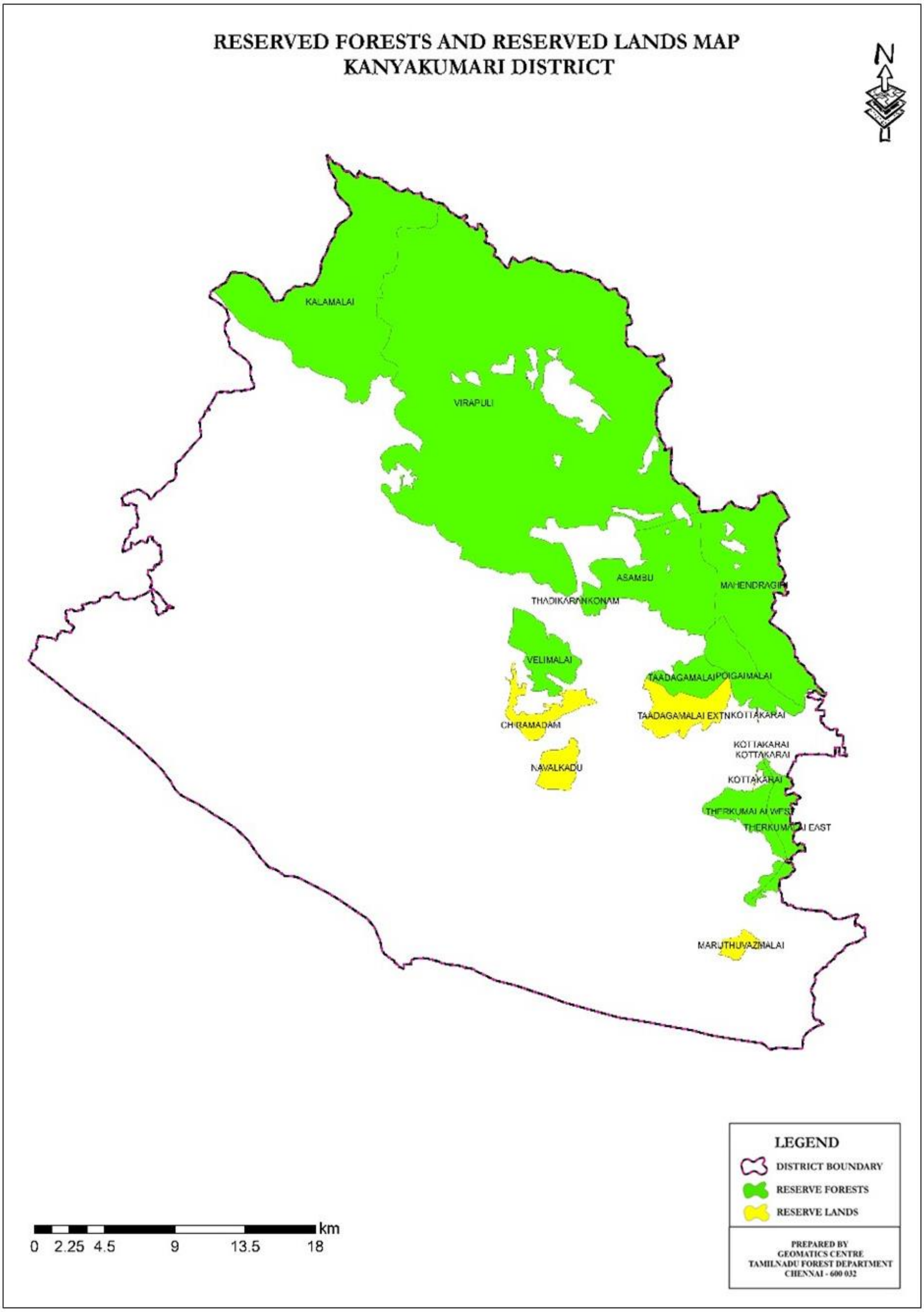


Figure 8.11.4. Map of Notified forests in Kanyakumari district



12. KARUR

Karur has a total geographical area of 2,904 sq.km. This district has 118.64 sq.km. of forest land, which includes 22 reserved forests (with 67 sq.km.), 2 reserved land (with 0.3 sq.km.) and the rest are unclassified lands. Initially there was no VDF in Karur until 2015. In 2017, 3 sq.km. of dense forest was recorded in the ISFR report for the first time. Furthermore, it got reduced to 2.24 sq.km. and remains same till 2021. The open forest and the moderately dense forest category are the main contributors to the forest cover of this district.

The Open Forest category has been decreasing until 2011, there after it continued to increase until 2017 to 83 sq.kms., it marginally decreased to 73.82 square kilometre as per the ISFR 2021 report. The moderate forest category continued to increase gradually from 2003 to 2019 i.e from 13 square kilometres to 43.01 square kilometres. This has largely contributed to the increase in the total forest cover area of district which is at present 118.64 square kilometres. The total forest cover of this district represents 4.09 percentage of the total geographical area. There is a good scope to increase the tree outside forest cover in the scrublands.

Table 8.12.1: Karur Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	2901	2901	2901	2901	2901	2901	2904	2904	2904
VDF	0	0	0	0	0	0	3	2.24	2.24
MDF	13	14	28	27	28	34	42	43.01	42.58
OF	75	74	60	61	66	87	83	73.21	73.82
TFCA	88	88	88	88	94	121	128	118.46	118.64
Percent	3.03	3.03	3.03	3.03	3.24	4.17	4.41	4.08	4.09
Change	11	0	0	1	6	27	8	-9.54	0.18
Scrub	50	25	6	6	3	3	7	7.02	7.48

Figure 8.12.1: Trend analysis of Forest in Karur district

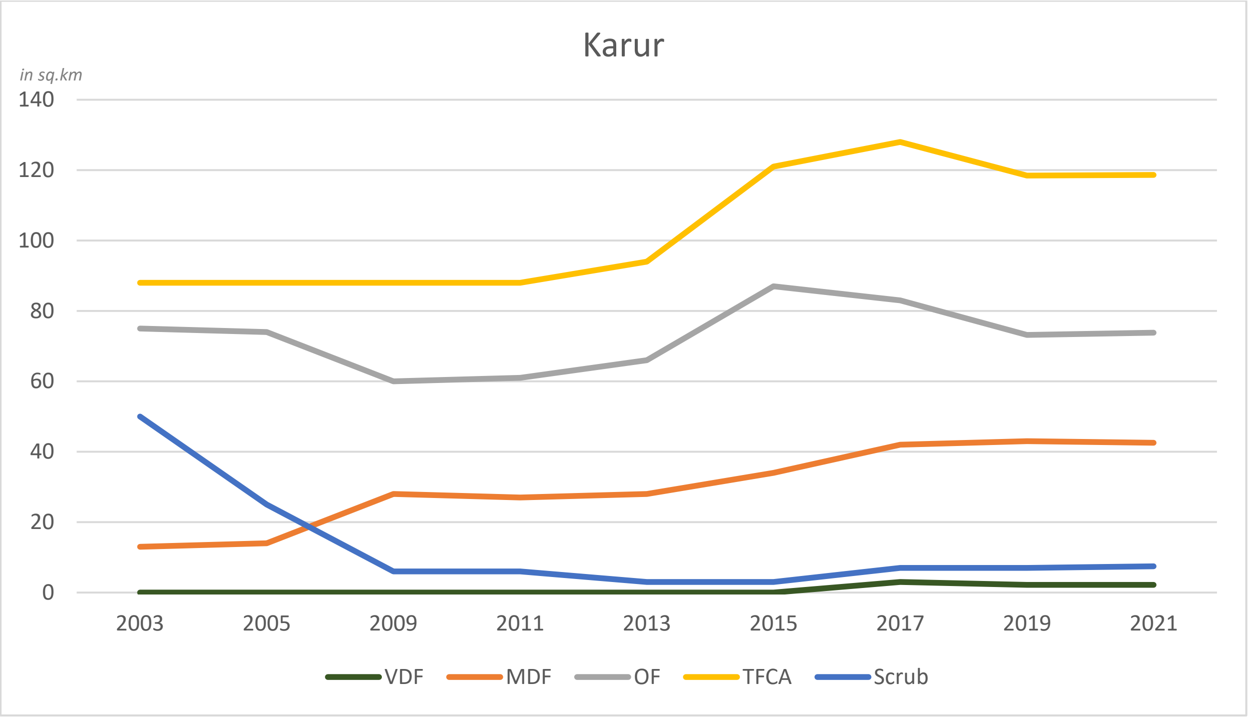


Figure 8.12.2. Share of Forest & non-forest area in Karur district (2021)

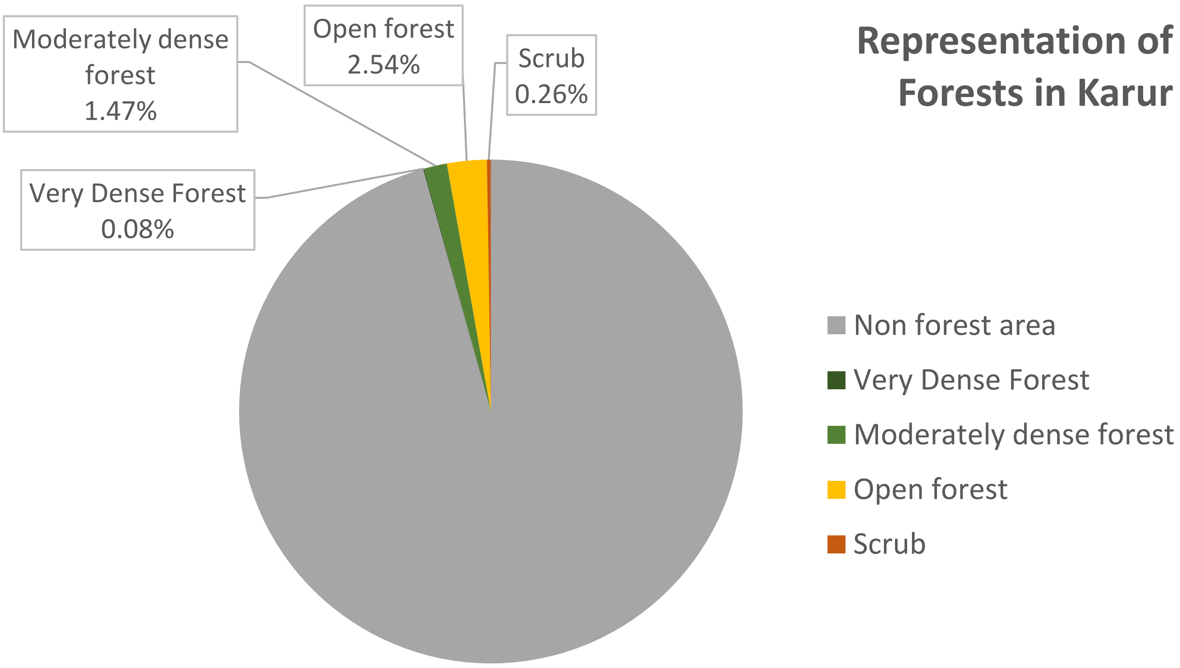


Figure 8.12.3. Forest Cover map of Karur district

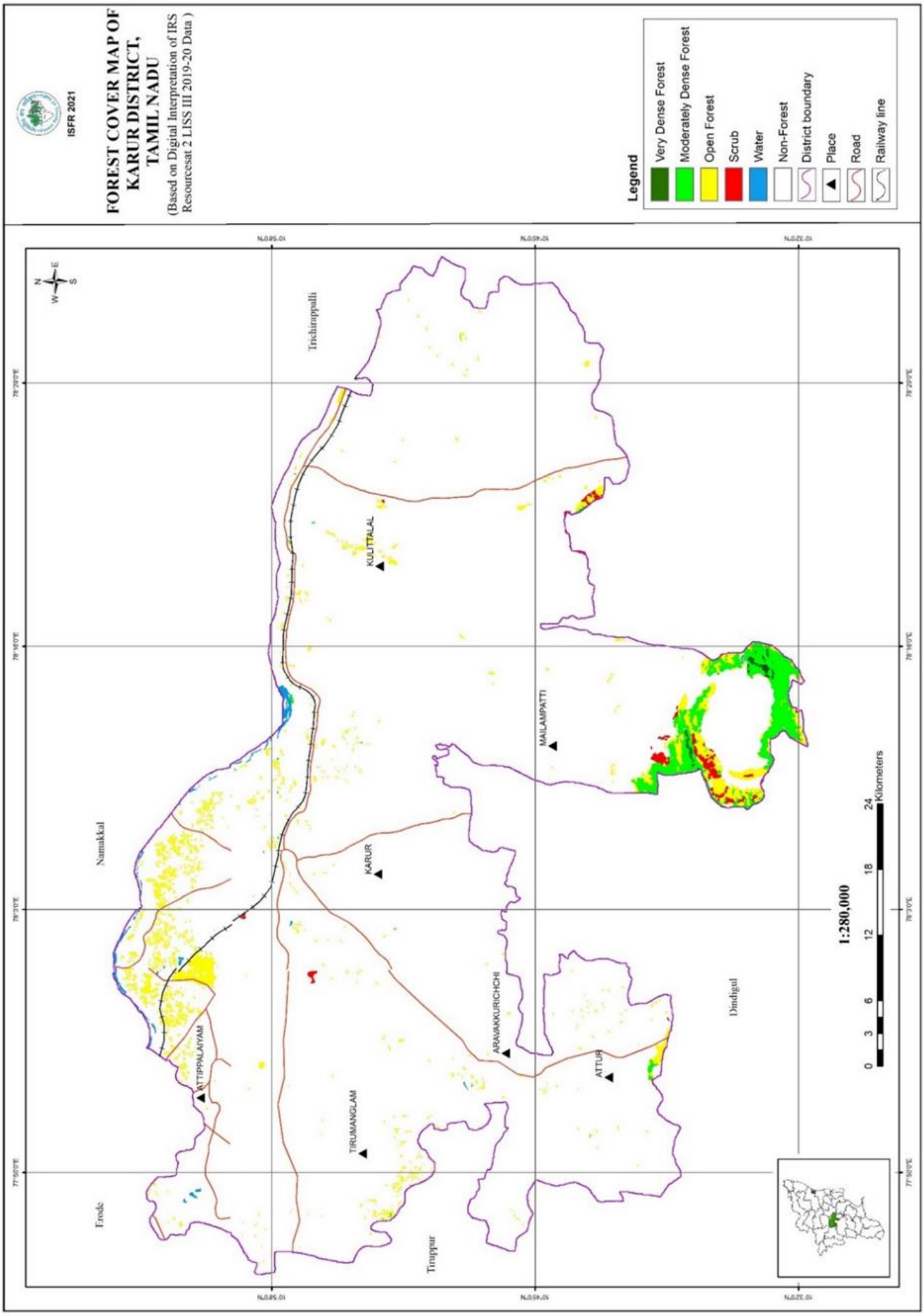
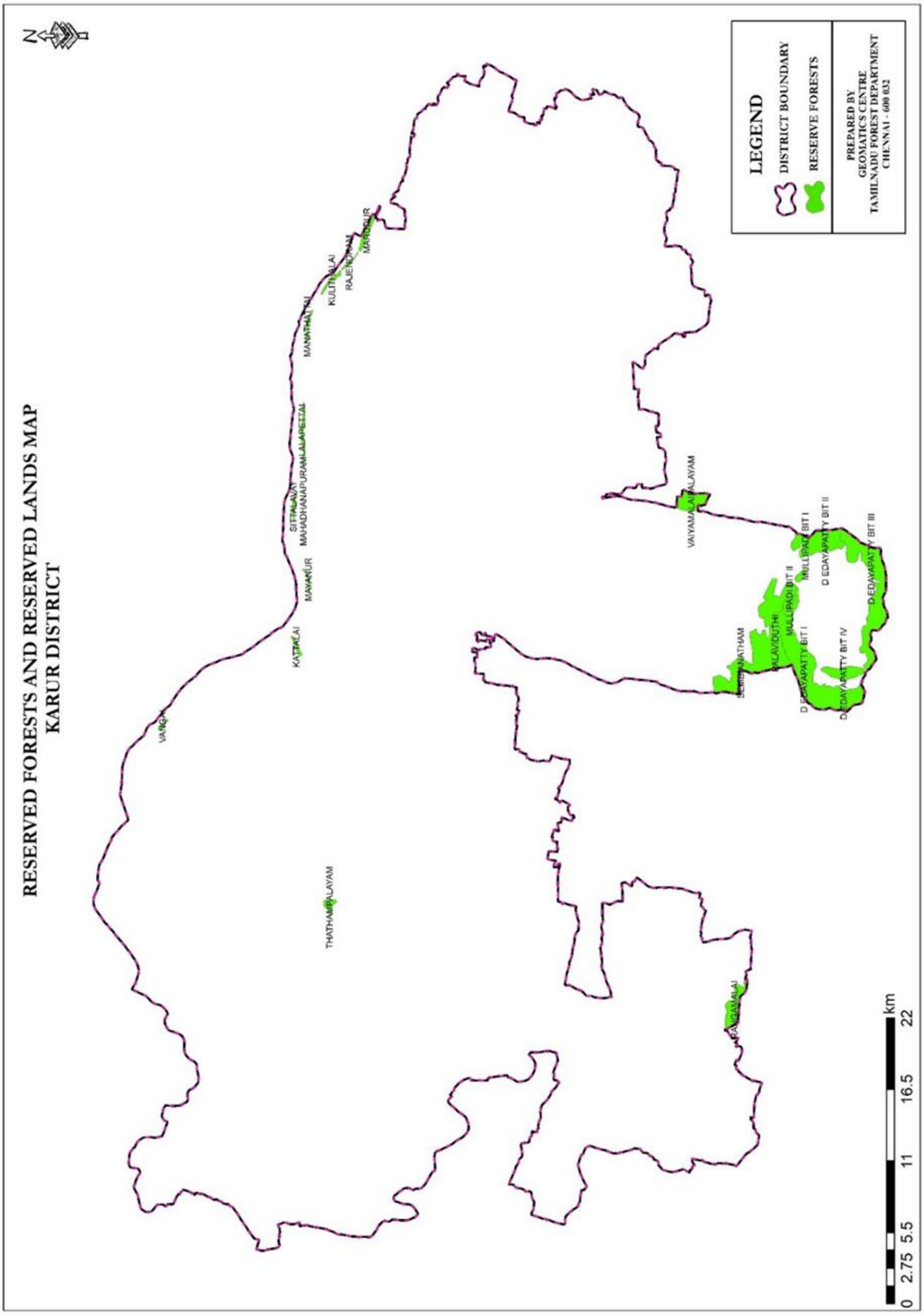


Figure 8.12.4. Map of notified forests in Karur district



13. MADURAI

The total geographical area of Madurai is 3710 square kilometres. The district has three density classes of forest – very dense, moderately dense and open forest category. Very Dense Forest category is estimated to be about 38.87 square kilometre in the ISFR 2021 report. This class has recorded a fluctuating trend with marginal increase and decrease in area. On comparing the area in 2003 and 2021, there is an increase of about 8.87 square kilometres in this forest category. With respect to the moderately dense forest category, the estimated area was increasing from 2003 to 2013, there after it had a steady decrease in the forest area. The open forest area also shows a varying trend with sharp increase and decrease in the area. However, on comparing the open forest area in 2003 and 2021, there is a loss of about 20 square kilometres. The fluctuations in the three different density classes had contributed to the varying trend of the total forest cover area in Madurai. During the period 2003 to 2015, the total forest cover area increased from 531 to 774 square kilometres, but from 2017 the total forest cover area continued to decrease to reach 553 sq.km. in 2021. This is about 14.91% of the Madurai's total geographical area. Madurai has a record of large scrub land area which is about 33.05 square kilometres as per ISFR 2021 report. The forest cover of Madurai has the representation of all three density classes; the major concern here is the invasive species - *Prosopis juliflora*. This species is spread over large tracks of unused government and private lands and has also contributed to the increase in the fallow land. Effective management of this invasive species in the area within the forest and outside the forest should be carried out immediately in order to ensure the protection of local biodiversity and also to improve the forest quality. Special strategies should be developed for this effective management without compromising on the existing tree cover recorded in this district.

Table 8.13.1: Madurai Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	4277	4277	4277	4277	4277	4277	3710	3710	3710
VDF	31	31	23	23	23	31	40	39.51	38.87
MDF	197	196	291	293	291	279	231	232.2	232.76
OF	303	317	254	271	288	464	290	283.41	281.59
TFCA	531	544	568	587	602	774	561	555.12	553.22
Percent	12.42	12.72	13.28	13.72	14.08	18.1	1512	14.96	14.91
Change	17	0	4	13	15	172	12	-5.88	-1.9
Scrub	144.5	204	134	117	105	21	32	31.91	33.05

Figure 8.13.1. Trend analysis of forest in Madurai distrcit

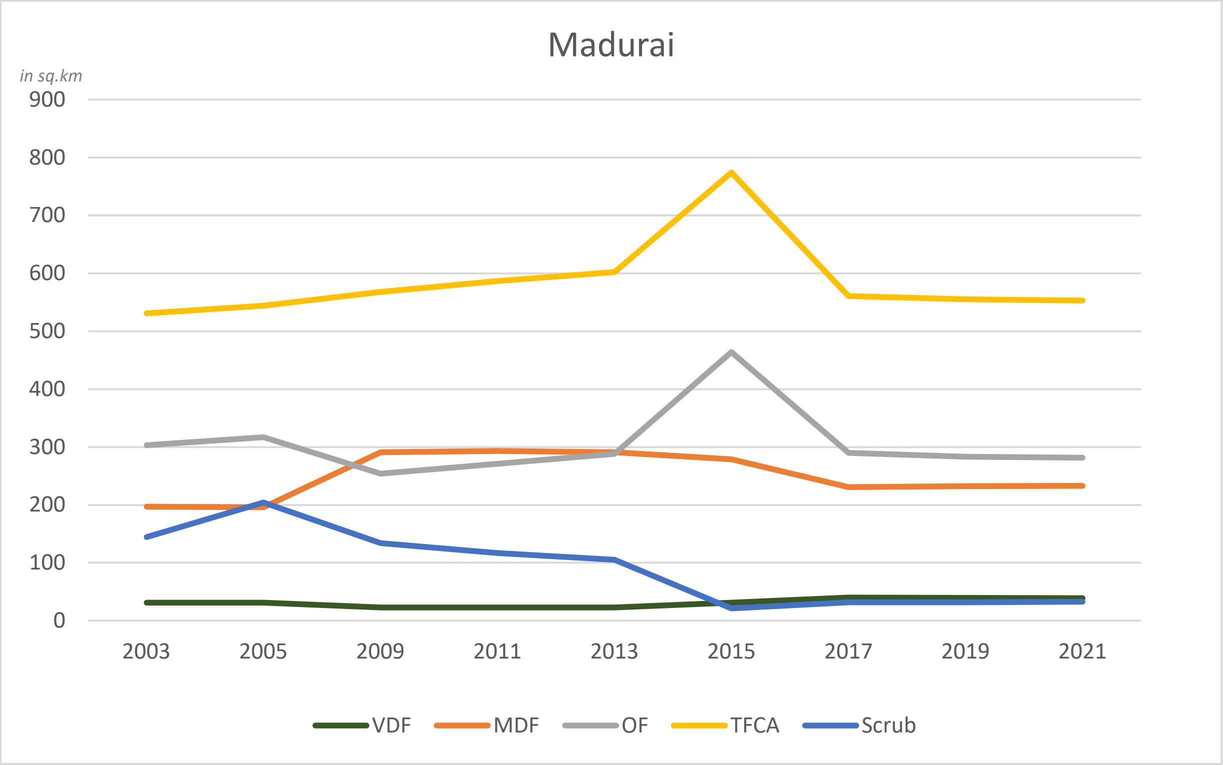


Figure 8.13.2. Share of Forest & non-forest area in Madurai (2021)

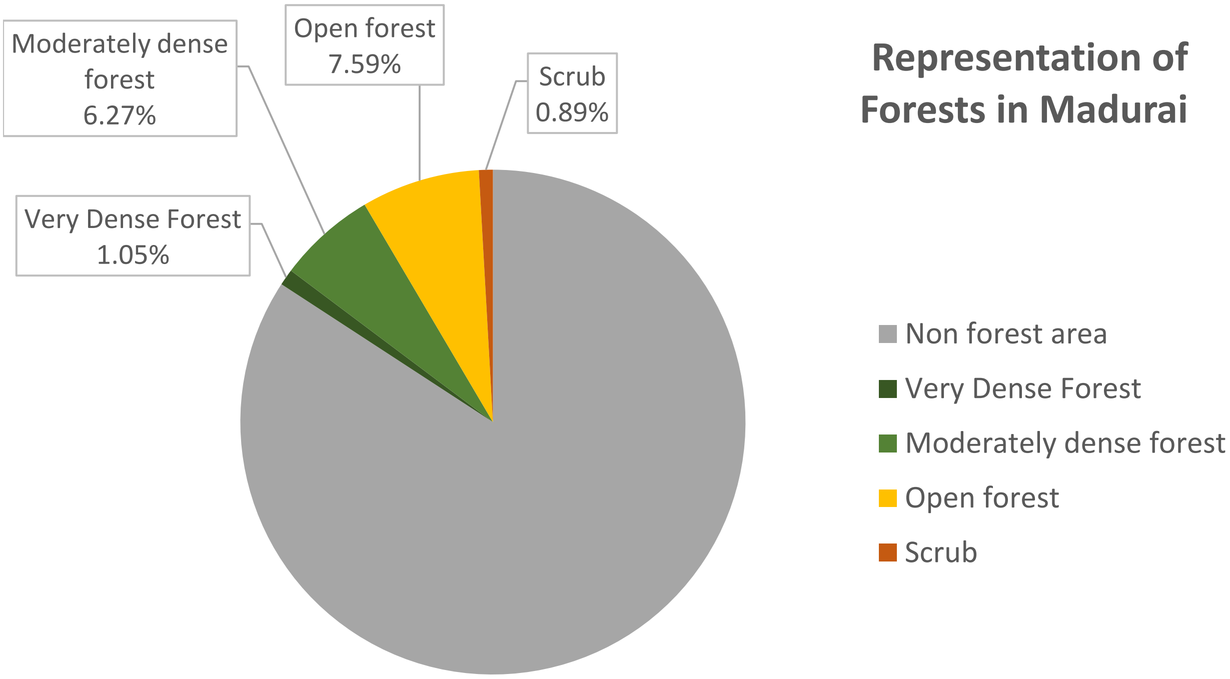


Figure 8.13.3. Forest Cover map of Madurai district

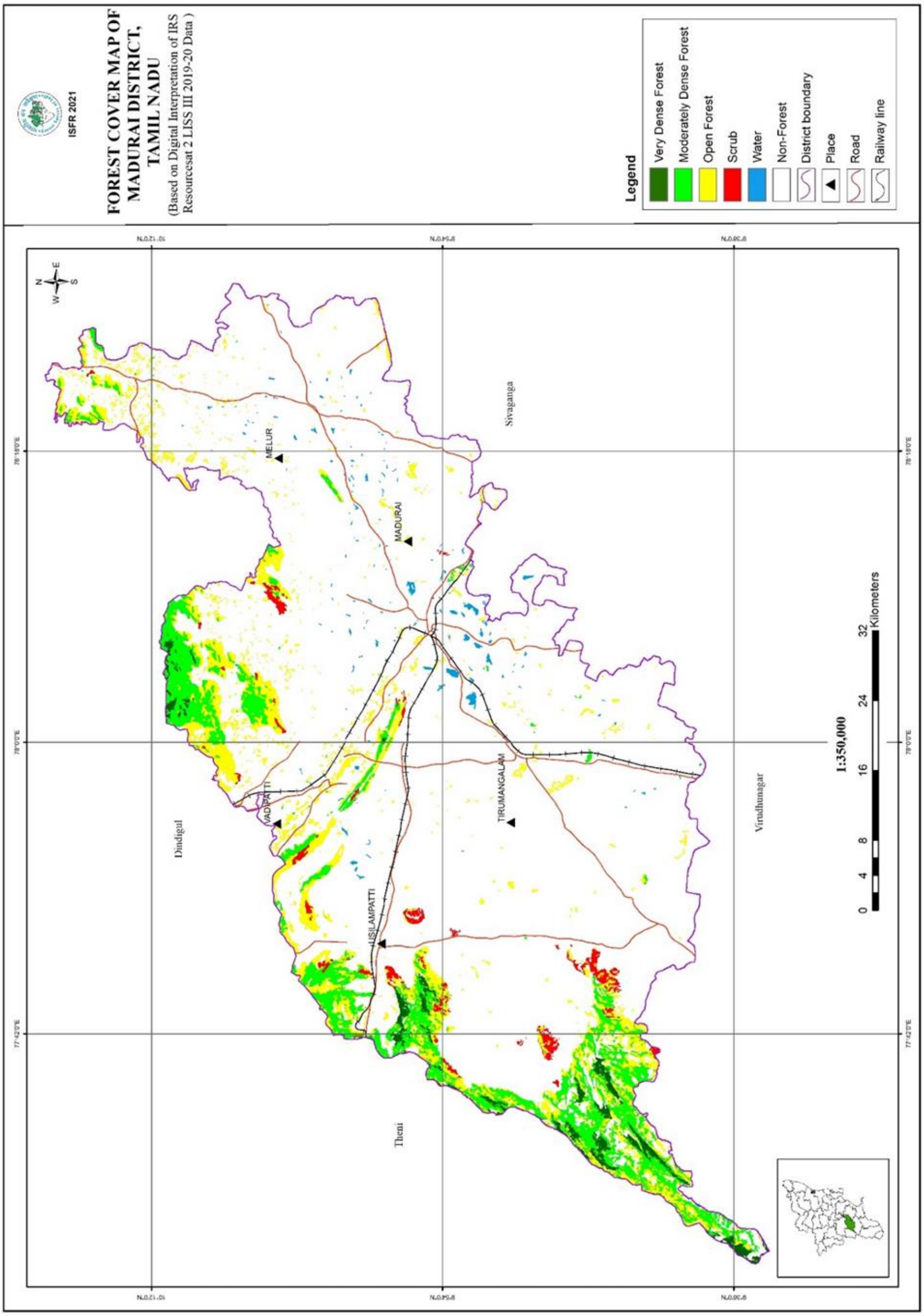
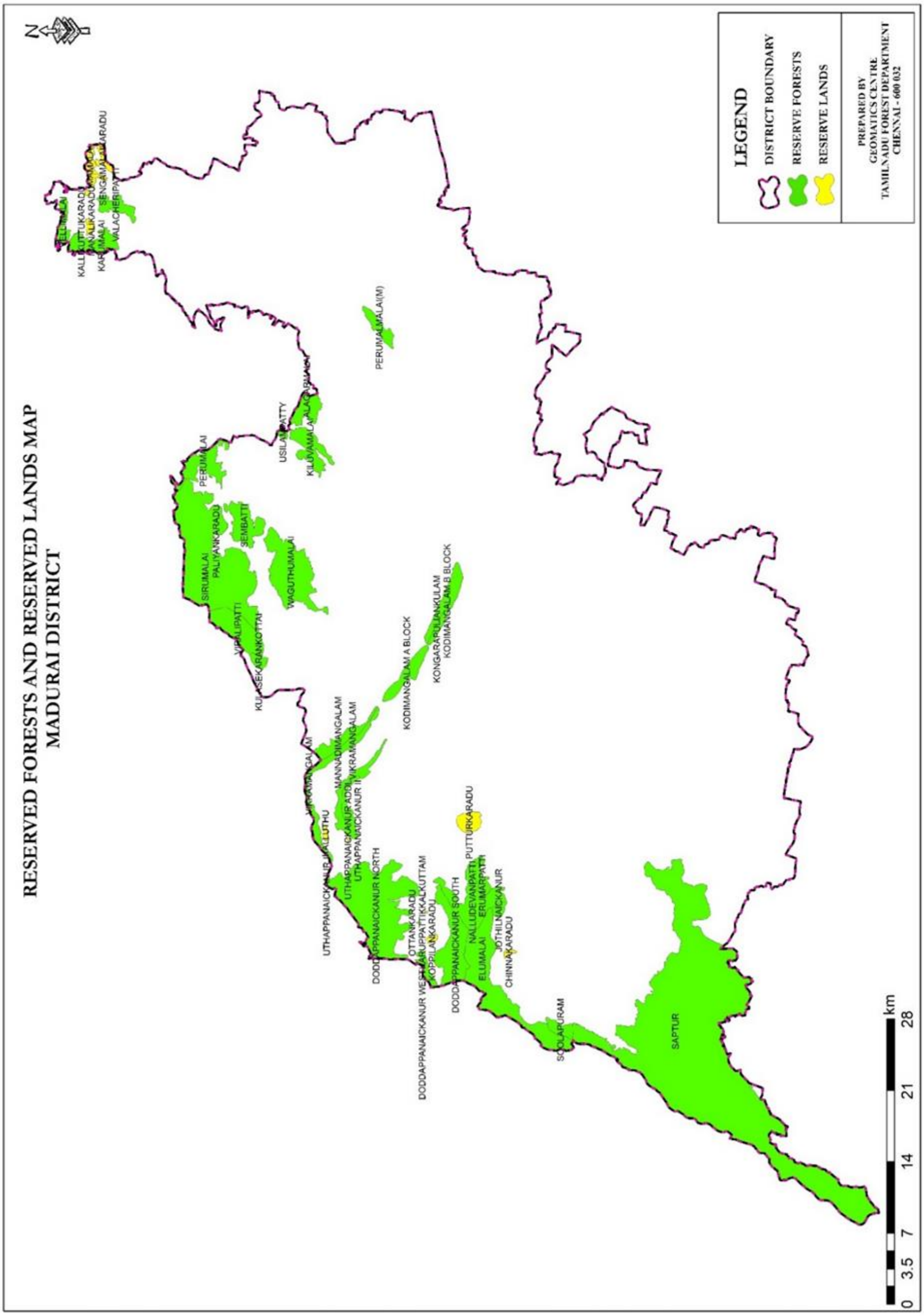


Figure 8.13.4. Reserved Forest map of Madurai district



14. NAGAPATTINAM

Nagapattinam is a coastal district in the Cauvery delta region of Tamil Nadu. This district has a part of the famous Point Calimer Bird Sanctuary which was the first Ramsar site in Tamil Nadu. There are 55 reserved forests and four reserve lands which contributes about 55.65 square kilometres of recorded forest area while the unclassified land is about 104.5 square kilometres. Though Nagapattinam has a good amount of recorded forest area, the forest cover of this district is only 6.1 percentage of the total geographical area. The dense forest category is absent in this district. The moderately dense forest category has been increasing from 16 square kilometre to 58 sq.km during 2003 to 2015. Thereon, it started to decrease to 23.48 square kilometre in 2021. Open forest category increased from 37 square kilometre in 2003 to 99 square kilometre in 2011 and then decreased in 2013, then had an increase to reach 140 sq.km in 2015, followed by sharp decline to 112 square kilometre in 2017 and reached to 135.66 square kilometre in 2019. The total forest cover area also shows a similar trend with sharp rise and decline following the same pattern as the moderately dense and open forest. However, the overall total forest cover area has increased from 53 square kilometres to 156.68 square kilometre during the period 2003 to 2021.

In the year 2013 and 2017 there has been sharp decline in the forest cover area. One of the possible reasons for this could be the tropical cyclones during the year 2012 & 2016. Nagapattinam being a coastal district is prone to the effects of severe cyclone during the Northeast monsoon period. This has largely affected the forest cover in this district. The trees within the forest and outside the forest in the private lands got uprooted at large scale during these cyclones. Therefore, special attention in terms of choosing native variety of dwarf trees, creation of shelter belts/ wind belts and taking up timely preventive mitigation measures might help to reduce the effect of the cyclone over the trees in this region.

Table 8.14.1: Nagapattinam Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	2140	2140	2140	2140	2140	2140	2569	2569	2569
VDF	0	0	0	0	0	0	0	0	0
MDF	16	20	26	43	31	58	33	23.53	23.48
OF	37	41	32	99	68	140	112	135.66	133.2
TFCA	53	61	58	142	99	198	145	159.19	156.68
Percent	2.48	2.85	2.71	6.64	4.63	9.25	5.64	6.2	6.1
Change	-25	-3	5	18	-43	99	-22	14.19	-2.51
Scrub	14	1	0	0	0	0	0	0	0

Figure 8.14.1. Trend analysis of forest in Nagapattinam

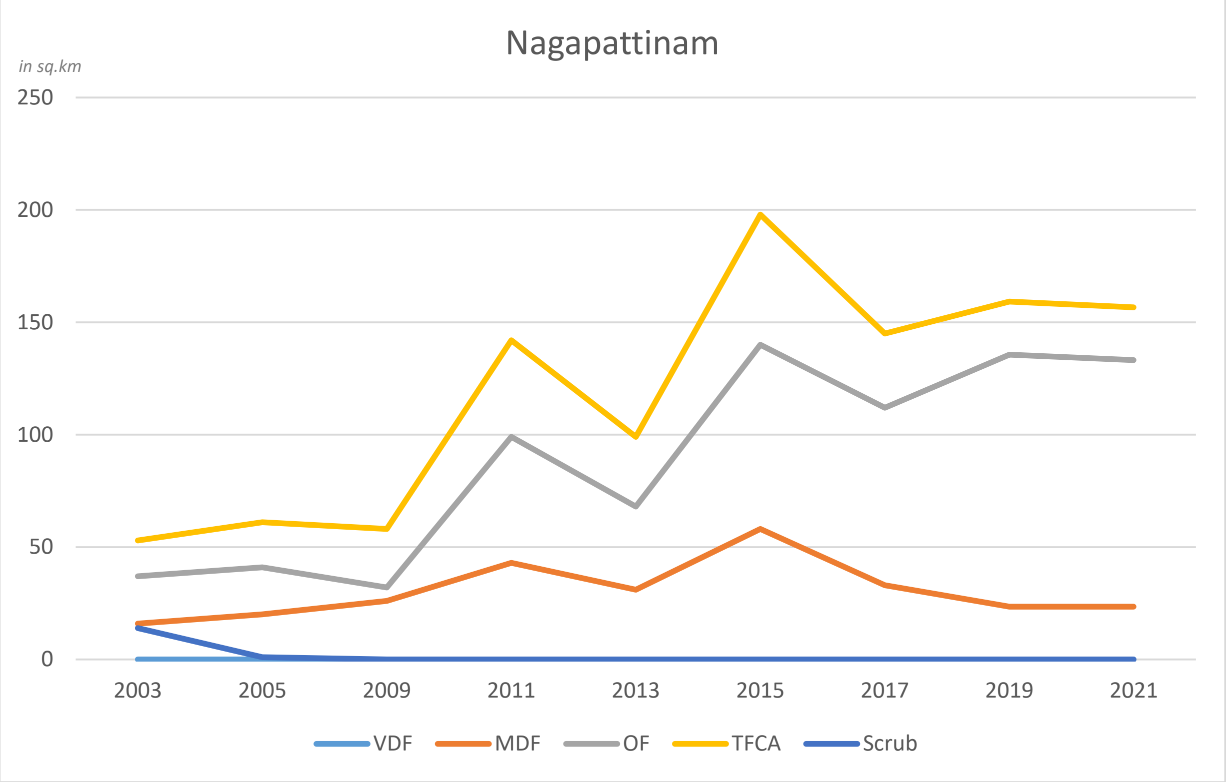


Figure 8.14.2. Share of Forest & non-forest area in Nagapattinam district (2021)

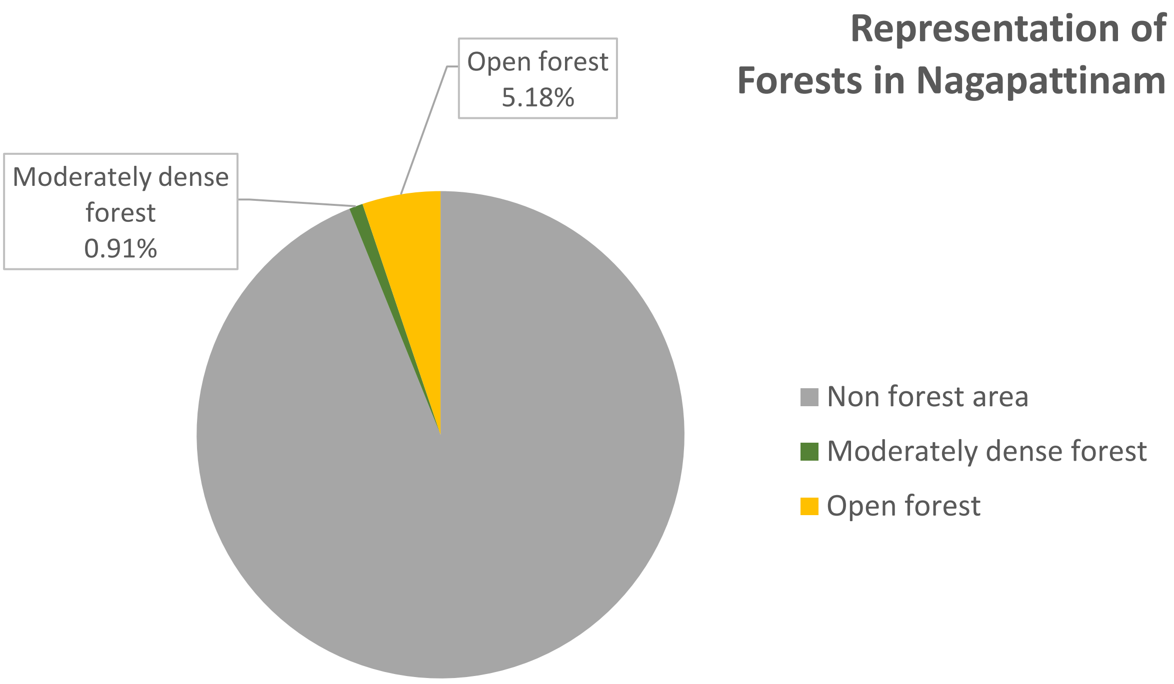


Figure 8.14.3. Forest Cover map of Nagapattinam district

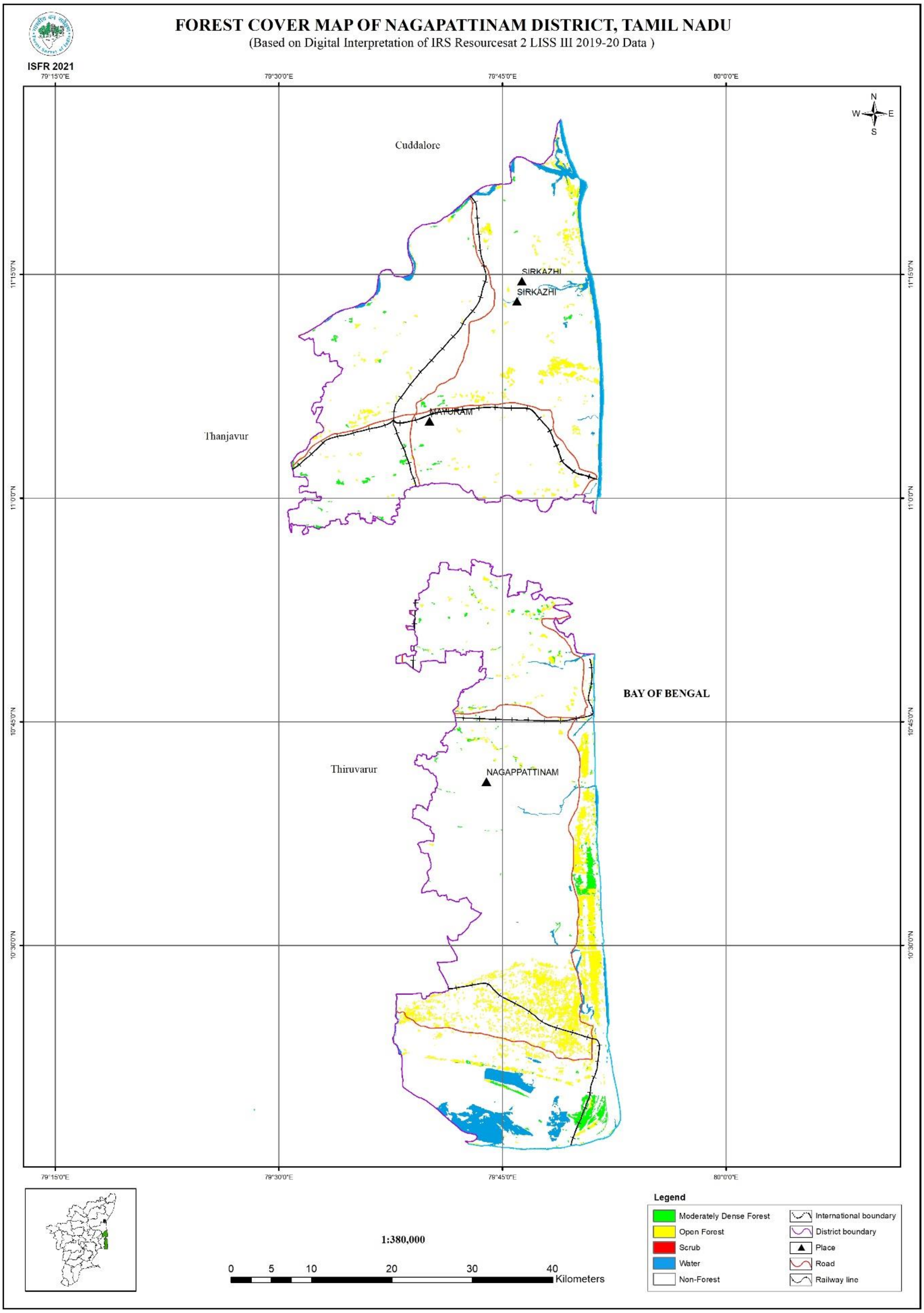
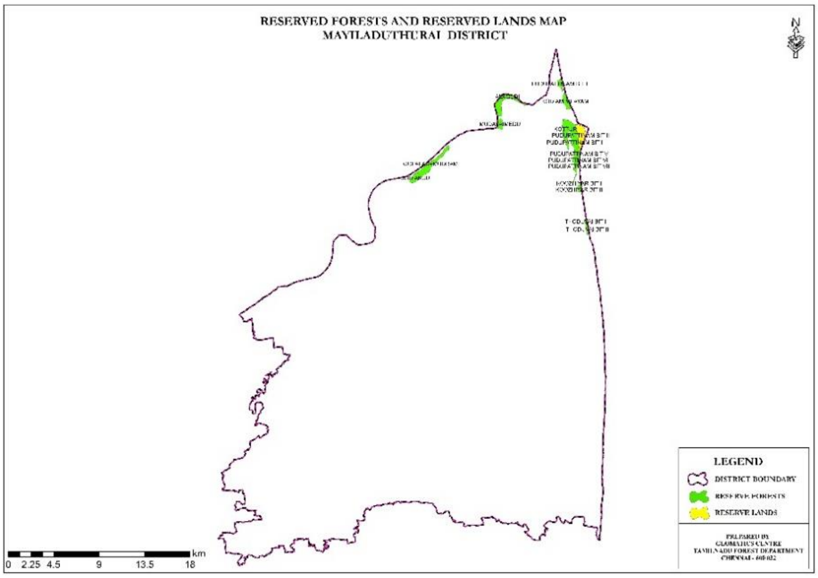
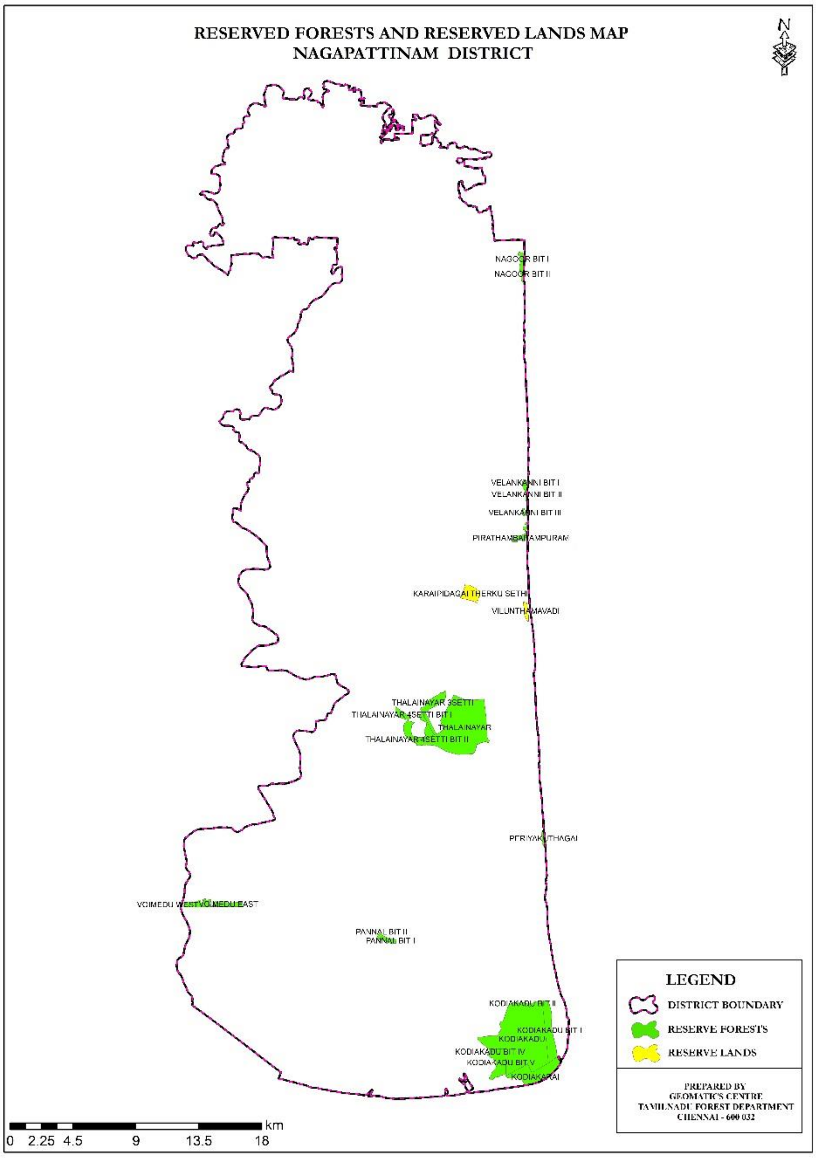


Figure 8.14.4. Map of notified forests in Nagapattinam district





15. NAMAKKAL

Namakkal district`s total geographical area is 3,420 sq.km. and it has 580.89 sq.km. of total forest cover area. The total recorded forest area is 505.70 sq.kms. There are 43 reserved forests that contribute 462 sq.km and 17 reserved lands that contribute 43.59 sq.km. to the recorded forest area while the remaining area is unclassified land. The difference in the total forest area and the recorded forest area of this district indicates that a good portion of the tree cover is outside the recorded forest area. Agro-forestry could be a possible factor for this contribution to the TOF (Tree outside forest). The dense forest of this district has increased during the period 2003 to 2021. But the trend of the moderate forest category has been fluctuating with sharp fall in 2009 and steady increase thereafter. The open forest category has increased initially but in 2017 there was a sharp decline. Though there were sharp fluctuations in the both the moderate and open forest category, the values between 2003 and 2021 does not show a major difference. From the line graph, one can clearly understand MF and OF have close correlation with each other; if one class decreased, the other got increased. This trend has continued all over the study years.

Overall, the forest cover in the district has increased about 30 sq.kms due to the dense forest category. This is a very good indicator as it highlights the efforts of conservation measures. Though the status of forest in this district has been good, the total forest cover contributes only 16.99% of the total geographical area of the district. To achieve the target of 33 % forest cover, it is necessary to focus on increasing the area of the moderate and open forests by intensive planting within the recorded forest area. As there is a scope to increase the TOF area, intensive measures to promote agro-forestry and taking up tree plantation drives in common lands can be carried out.

Table 8.15.1: Namakkal Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	3413	3413	3413	3413	3413	3413	3420	3420	3420
VDF	40	40	55	55	55	54	84	83.75	83.41
MDF	294	294	189	189	190	211	284	283.58	283.97
OF	217	209	300	300	319	309	212	211.72	213.51
TFCA	551	543	544	544	564	574	580	579.05	580.89
Percent	16.14	15.91	15.94	15.94	16.53	16.82	16.96	16.93	16.99
Change	31	0	-1	0	20	10	4	-0.95	1.84
Scrub	142	68	22	22	53	7	20	20.08	24.25

Figure 8.15.1. Trend analysis of forest in Namakkal

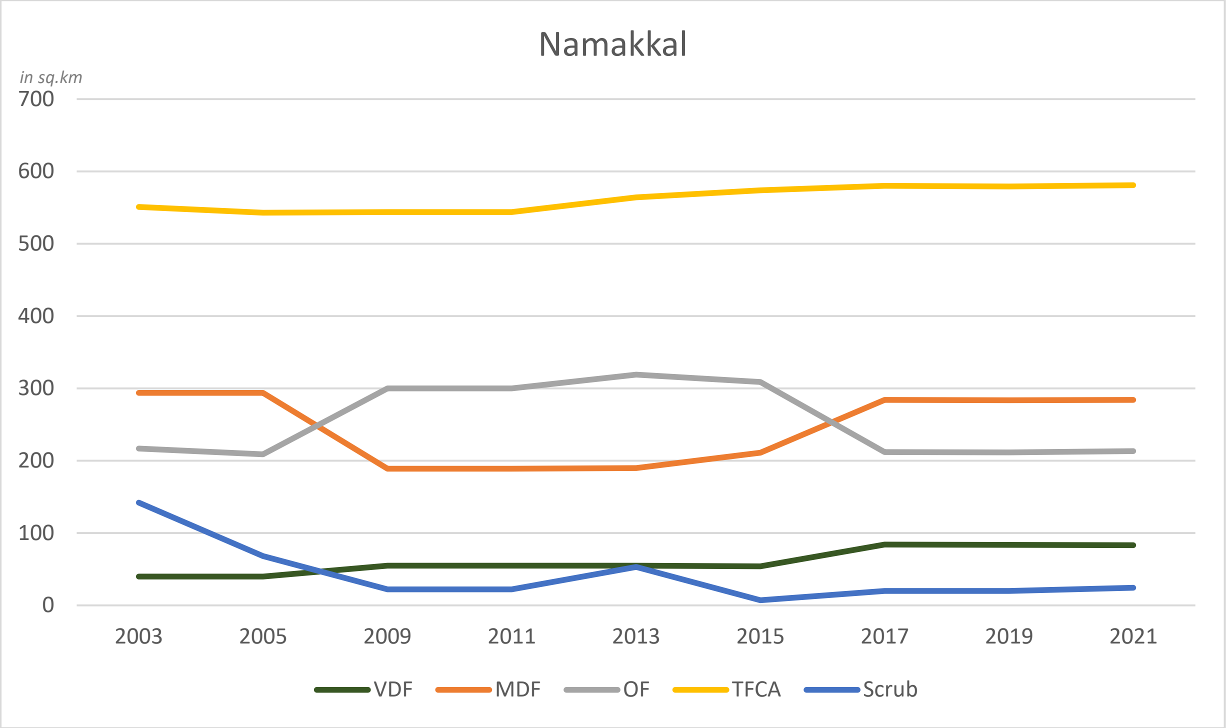


Figure 8.15.2. Share of Forest & non-forest area Namakkal district (2021)

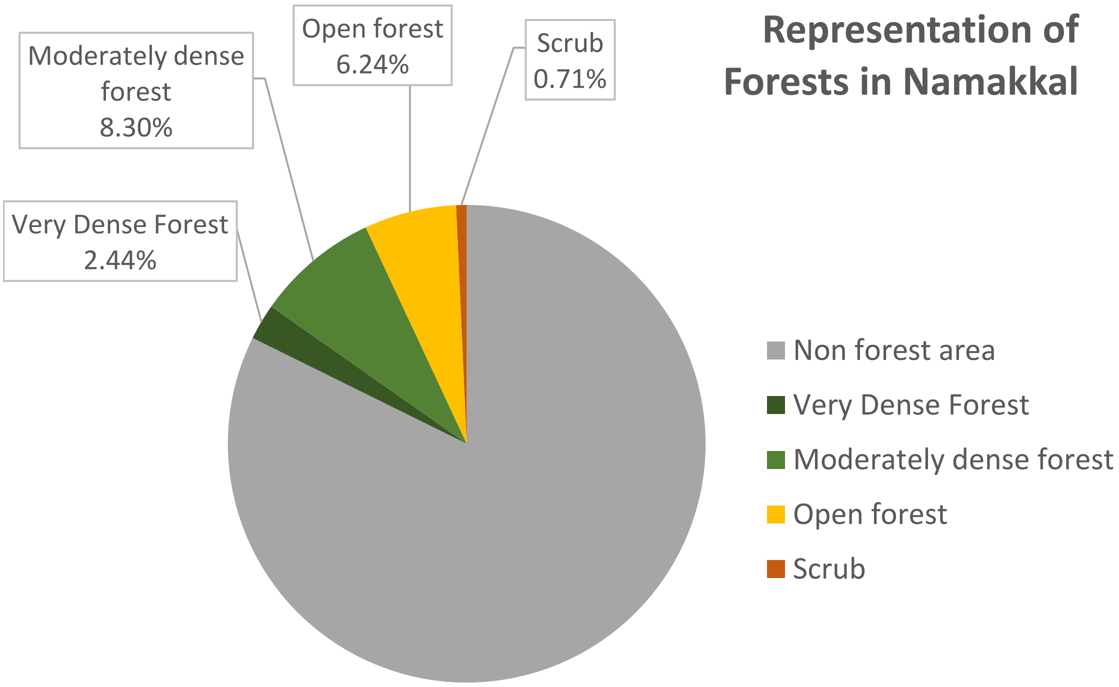


Figure 8.15.3. Forest Cover map of Namakkal district

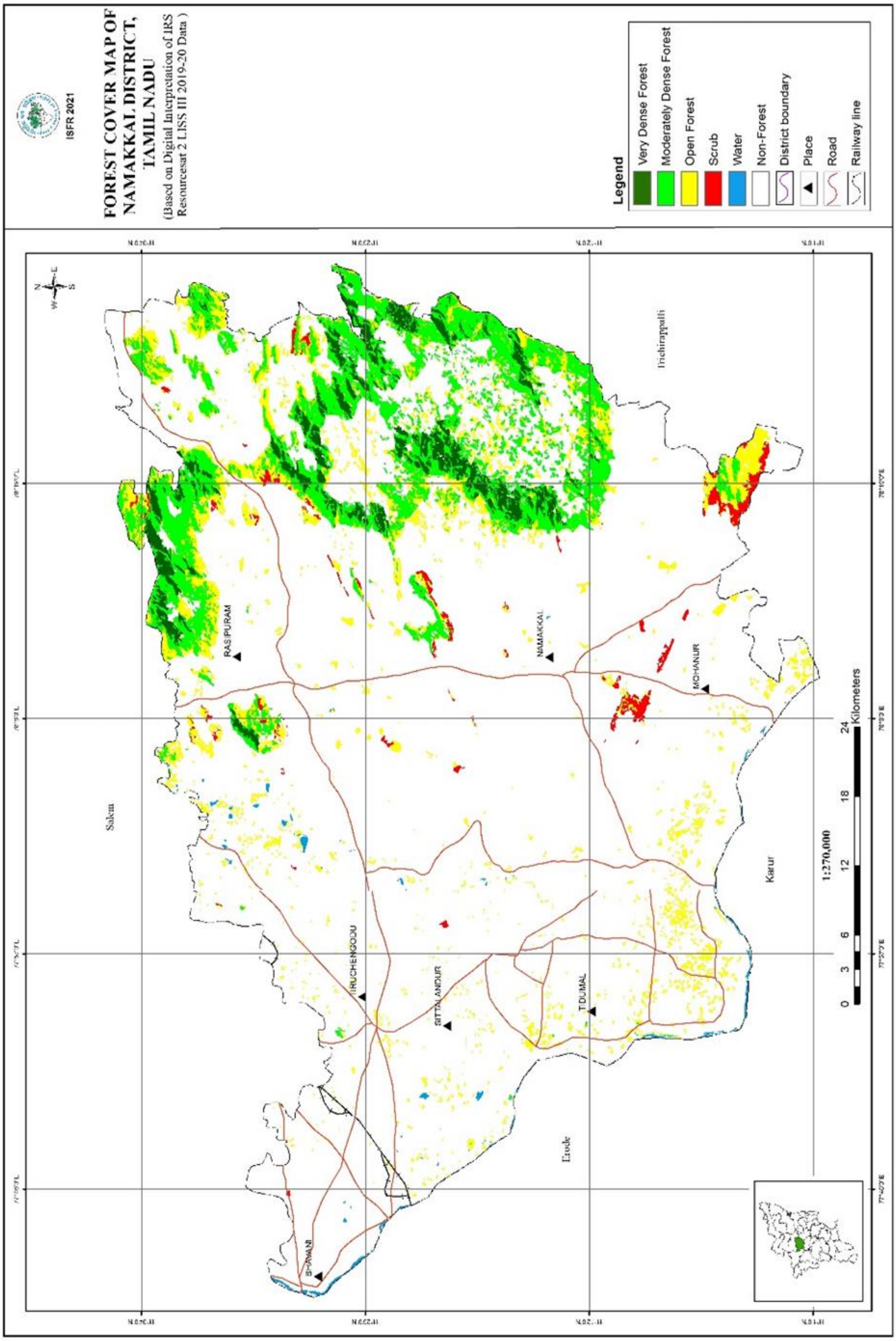
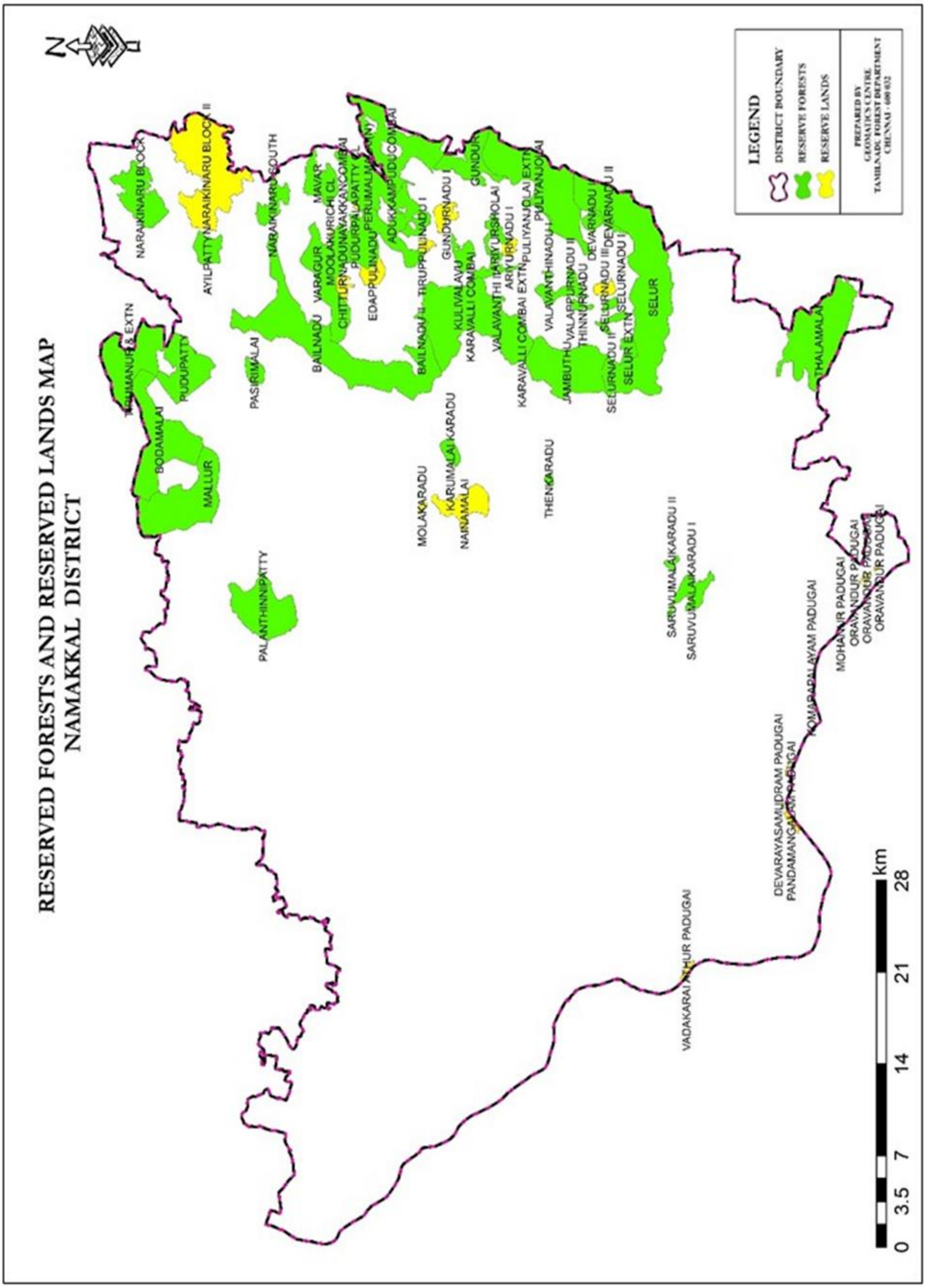


Figure 8.15.4. Map of notified forests in Namakkal district



16. PERAMBALUR

Perambalur has a total geographical area of 1756 sq.kms and about 142.17 sq.km. is estimated as total forest cover area, which was 8.1% of the total area. There are 24 reserved forests which contributes 163.3 sq.km to the recorded forest area. The recorded forest area is more than the total forest cover area which indicates that there are some portions of the recorded forest area that do not contribute to the green cover of the district. There is a possibility that these parts are either degraded or could be barren. Spatial analysis using satellite images will clearly identify those patches.

Though the forest area is less in this district, it is interesting to note that about 10 sq.kms is under very dense forest category. But the table below indicates that since 2013, the very dense forest is continuously decreasing in this district. This is a serious concern which requires immediate attention in terms of closely following the existing dense forest patches and working towards the increase in the area of this category. The moderately dense forest has been decreasing until 2015, thereafter it increased in 2017. The open forest also increased initially until 2013 and then started to decline continuously. So, a closer watch on the existing forest cover patches is required to identify the reasons that cause these variations. The total forest cover area is also showing a varying trend with a steep decline in 2015.

The scrub land area continues to increase whereas the open forest is decreasing. This indicates the possibility that the open forest got degraded and moved to the scrub land category. Temporal analysis of the spatial data will be able to validate this assumption. The district and the state departments should focus on increasing the tree cover within the forest and outside the forest area in Perambalur.

Table 8.16.1: Perambalur Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	1748	1748	1748	1748	1748	1748	1756	1756	1756
VDF	9	9	19	19	19	18	10	10.03	10.03
MDF	54	57	36	35	35	37	65	64.81	64.81
OF	67	75	86	86	91	74	69	66.42	67.33
TFCA	130	141	141	140	145	129	144	141.26	142.17
Percent	7.44	8.07	8.07	8.01	8.3	7.38	8.2	8.04	8.1
Change	10	0	-1	0	5	-16	13	-2.74	0.91
Scrub	10	19	8	8	6	9	19	18.35	18.79

Figure 8.16.1. Trend analysis of forest in Perambalur

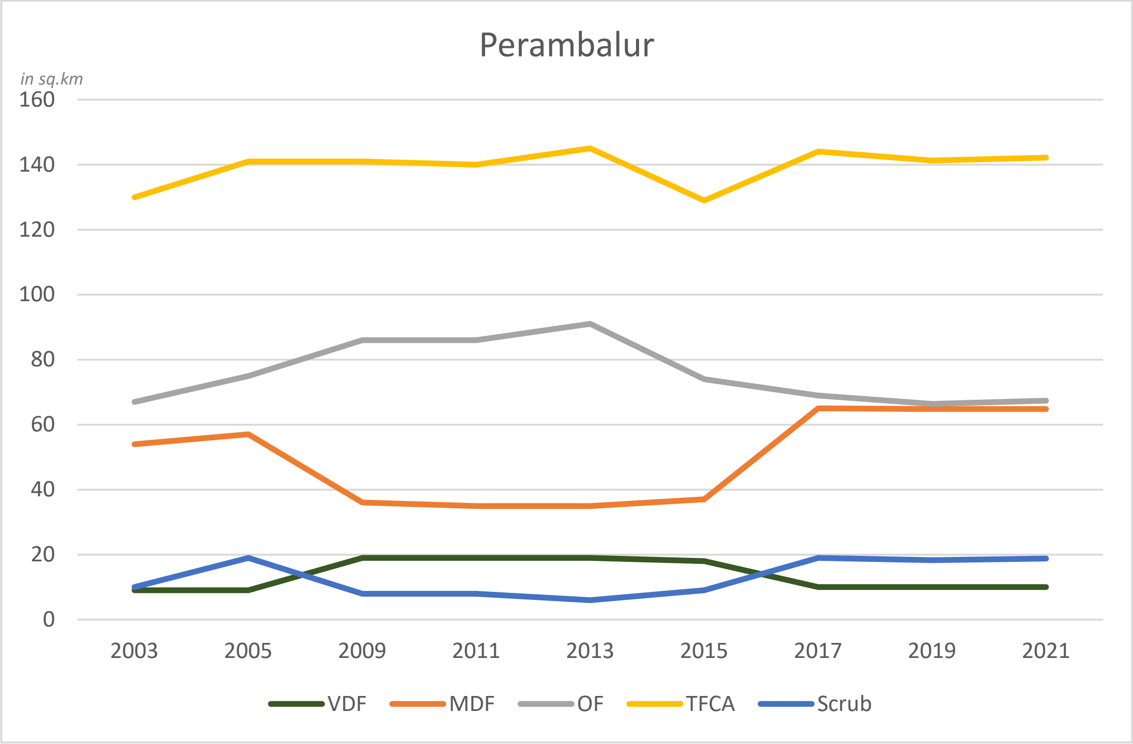


Figure 8.16.2. Share of Forest & non-forest area in Perambalur district (2021)

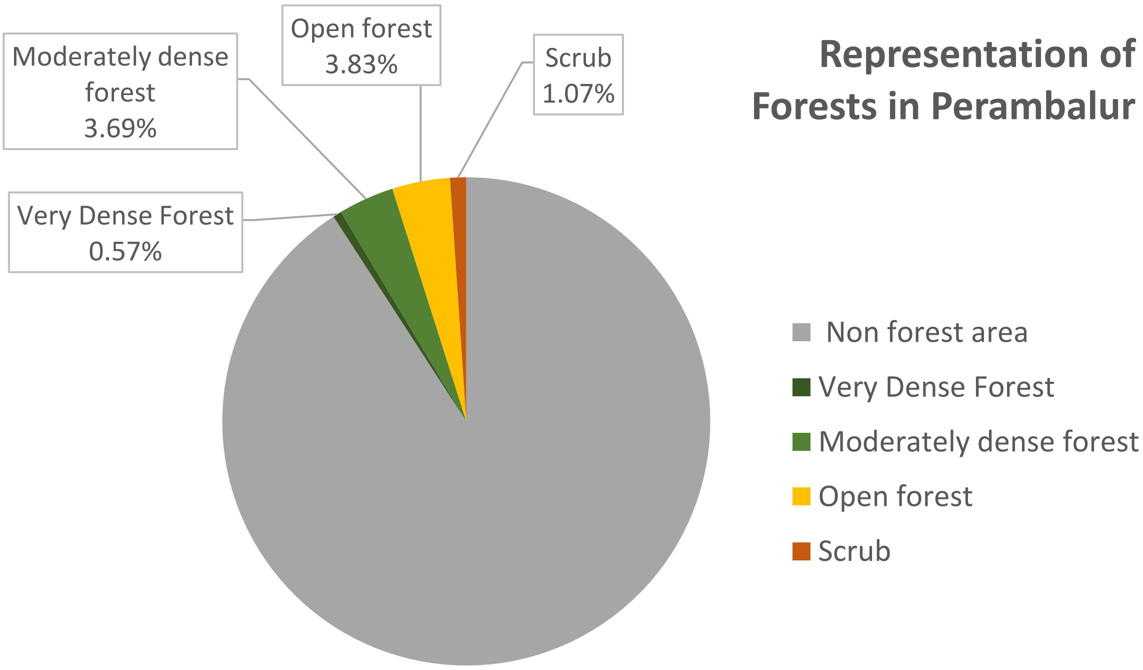


Figure 8.16.3. Forest Cover map of Perambalur district

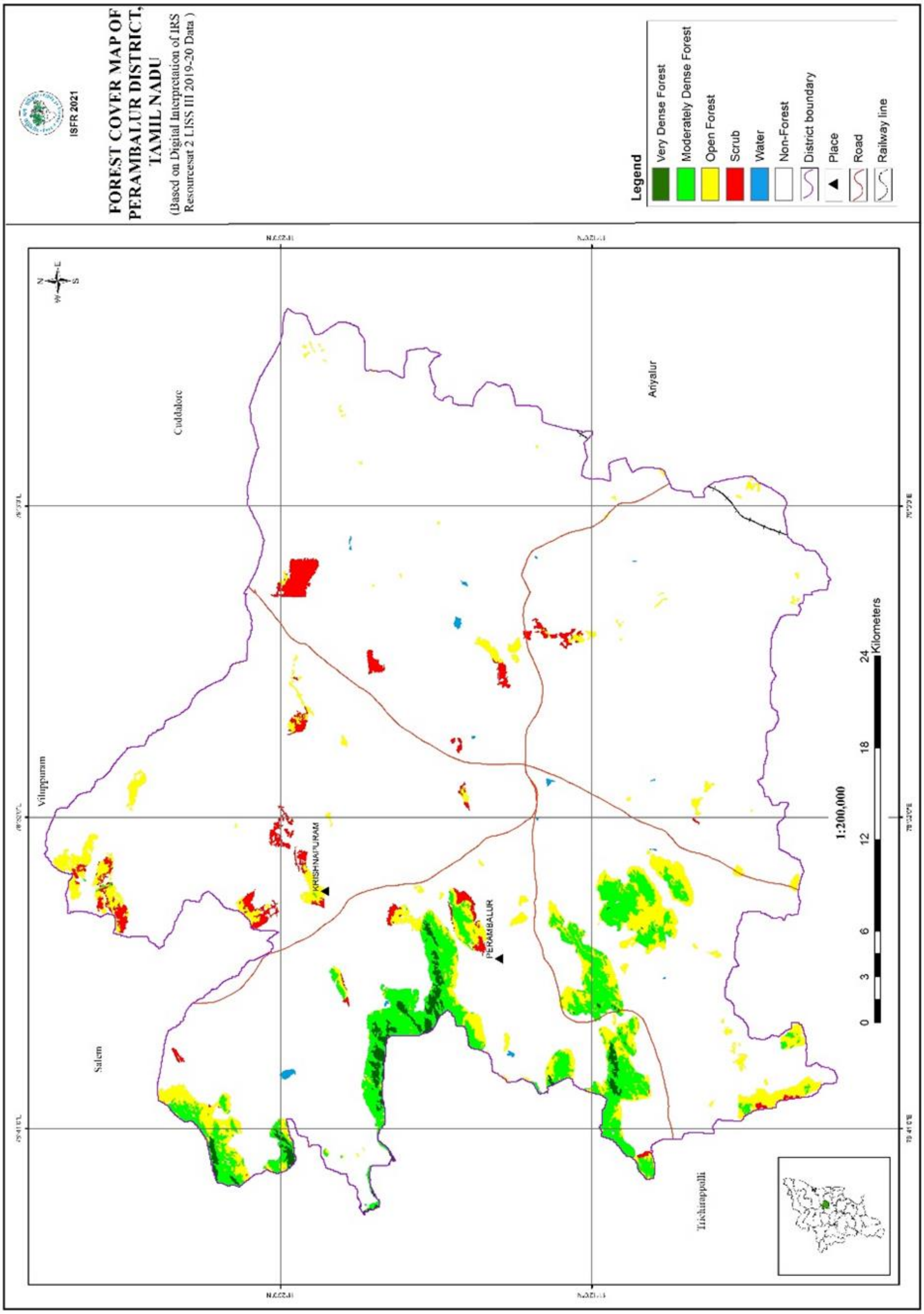
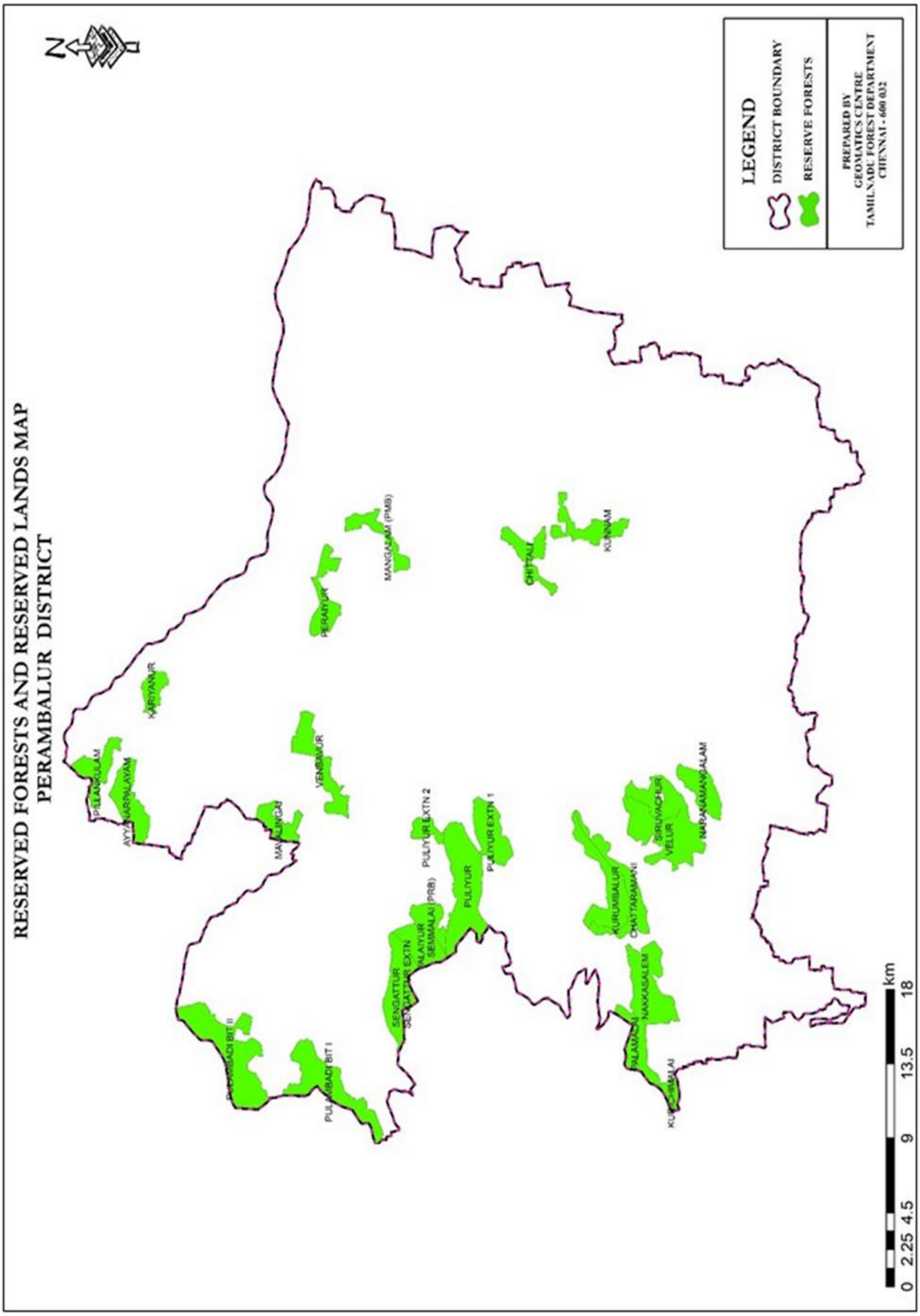


Figure 8.16.4. Map of notified forests in Perambalur district



17. PUDUKKOTTAI

Pudukkottai district has a total geographical area of 4,644 sq.km. km., of which only 8.12% has forest cover, which is about 377.13 sq. km. This district has 77 reserved forests with a total area of 195.94 square kilometres and three reserved lands with an area of 20.89 square kilometres. The total recorded forest area is 221.2208 sq.kms. This indicates that about 156 sq.kms of the tree cover is outside the recorded forest area.

Initially, the dense forest category in Pudukkottai was 0, later one square kilometre of VDF was estimated in 2017 for the first time. The moderate forest category records an overall increase in the area of about 25 sq.kms. The Open Forest, similar to MF, has been increasing since 2013. By 2021, it has reached 269.85 square kilometres and has an overall increase of about 110 sq.kms. The increase of MF and of contributed to the overall increase in the total forest cover area of Pudukkottai. About 139 sq.kms of increase in TFCA is observed in this district.

Pudukkottai district needs to increase its forest cover as only 8.12% of the district area constitutes the green cover. Special programmes at district level aiming for agro-forestry should be taken up. Soil moisture conservation works in the interior parts will help the survival of trees that are planted in those areas. Assessment of fallow lands and possible conversion of those lands into green spaces would also help the district to improve its green cover.

Table 8.17.1: Pudukkottai Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	4651	4651	4651	4651	4651	4651	4644	4644	4644
VDF	0	0	0	0	0	0	1	0.91	0.77
MDF	81	99	78	78	77	88	93	96.04	106.51
OF	157	142	174	177	204	245	268	267.84	269.85
TFCA	238	241	252	255	281	333	362	364.79	377.13
Percent	5.12	5.18	5.42	5.48	6.04	7.16	7.8	7.86	8.12
Change	15	-1	16	3	26	52	-23	2.79	12.34
Scrub	49.5	11	8	7	5	4	7.8	7.3	7.3

Figure 8.17.1. Trend analysis of forest in Pudukkottai district

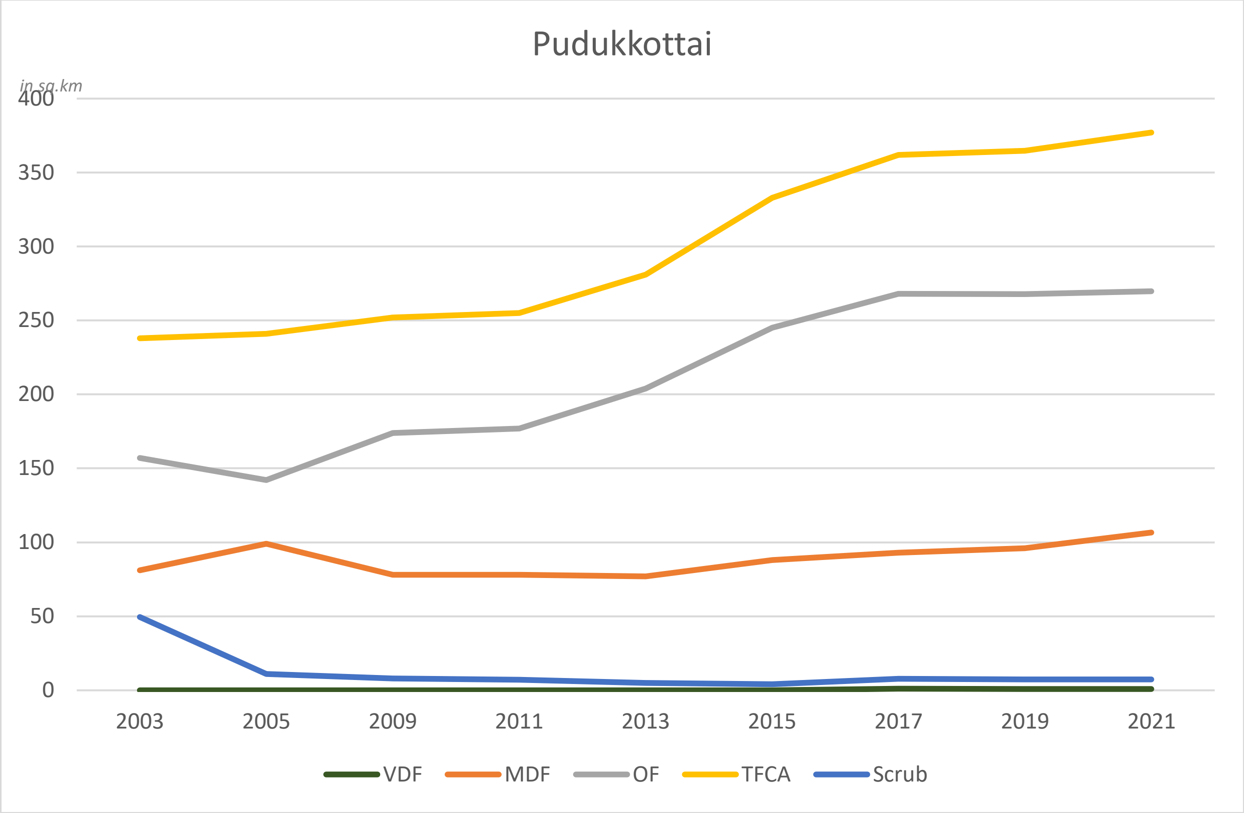


Figure 8.17.2. Share of forest & non-forest area in Pudukkottai district (2021)

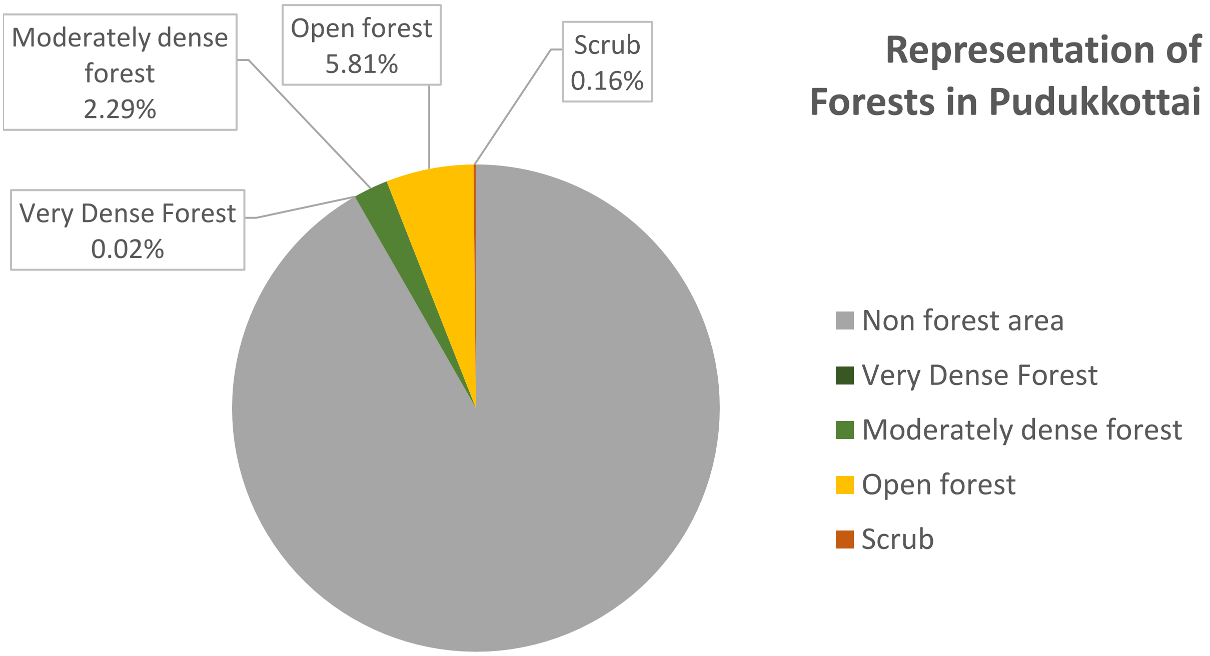


Figure 8.17.3. Forest Cover map of Pudukkottai district

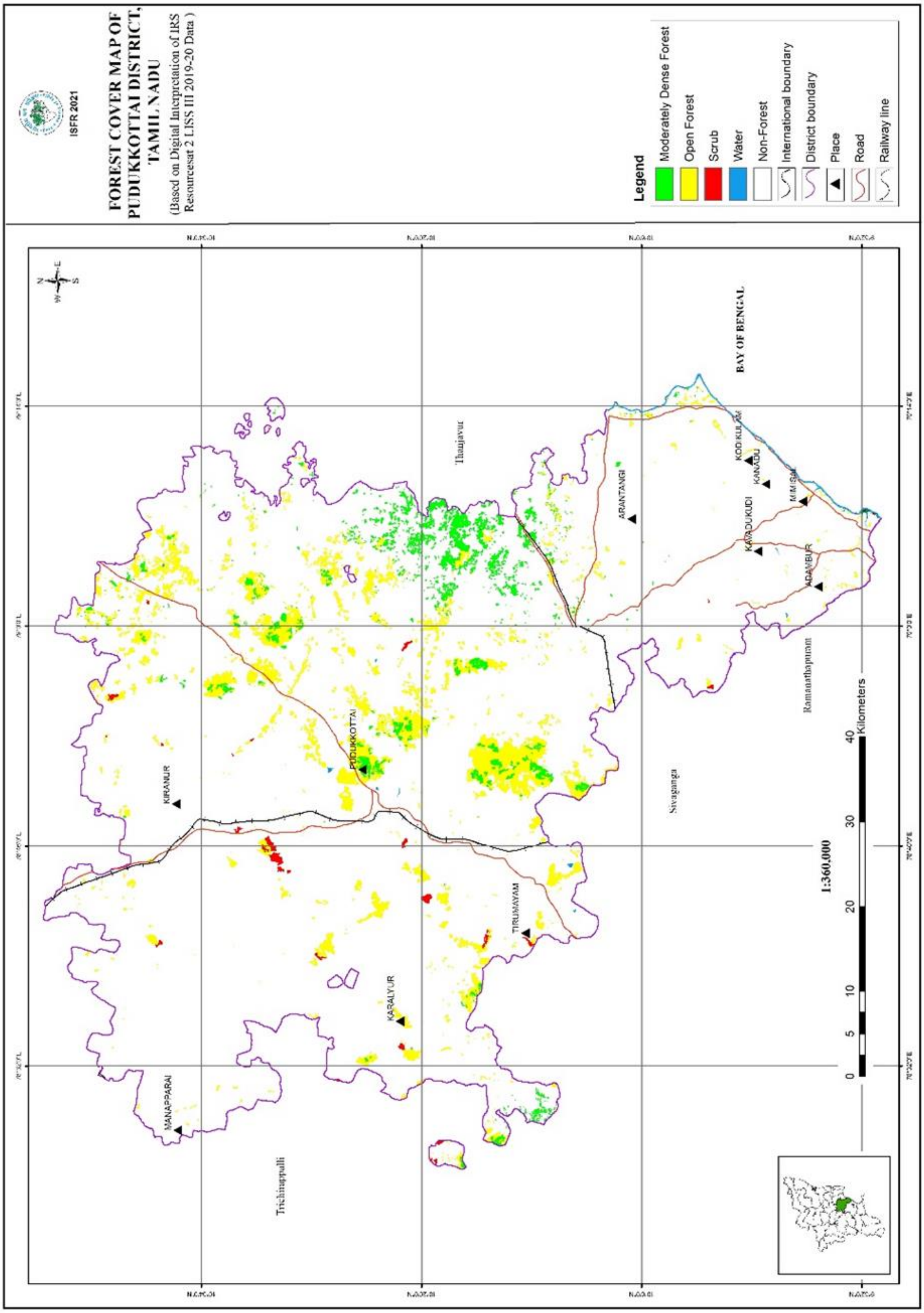
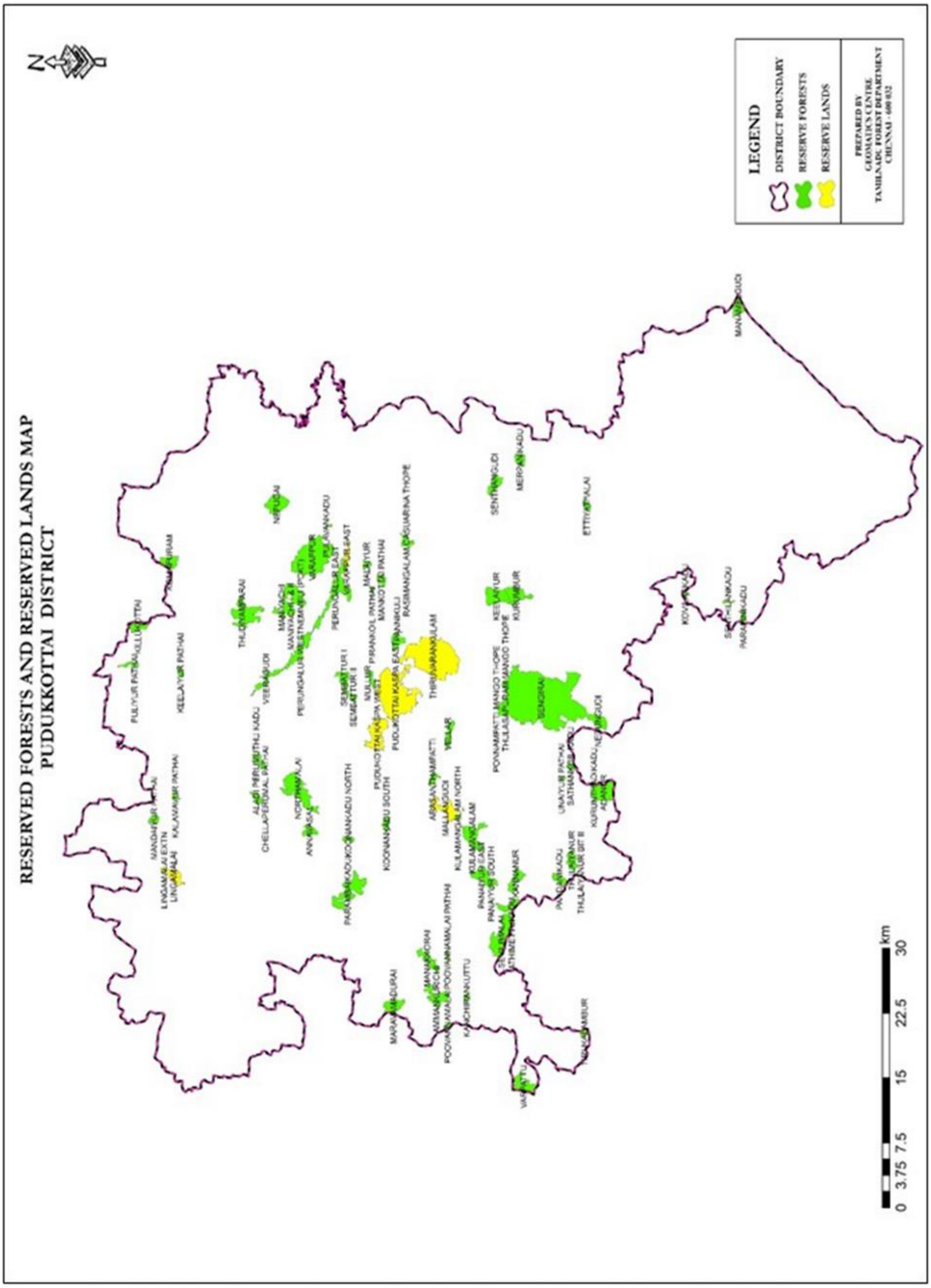


Figure 8.17.4. Map of notified forests in Pudukkottai district



18. RAMANATHAPURAM

Though Ramanathapuram is considered as one of the driest districts in Tamil Nadu, the district has the maximum number of bird sanctuaries in the state namely Kanjirankulam Birds Sanctuary, Chitrangudi Birds Sanctuary, Melaselvanur- Kilaselvanur Birds Sanctuary, Theerthangal Bird Sanctuary and Sakkarakottai Tank Birds Sanctuary. Ramanathapuram coast is a part of the Gulf of Mannar which is one of the largest Marine National Parks in the country and it is also a biosphere reserve. The total recorded forest area in this district is only 47.07 sq.kms with 11 reserved forests and 14 reserved lands.

The total forest cover area has been showing varying trend. In the recent years, the total forest cover has been decreasing. There has been a continuous loss in the moderately dense forest category of the forest class which should of a great concern for a district like Ramanathapuram with only 6% of the geographical area under the forest cover. So immediate measures have to be taken to initiate native tree plantation in the recorded forest areas and also in the bird sanctuaries. This is highly essential because the tree cover will help in ecological balance and also to reduce, the effect of raising temperatures due to climate change.

Table 8.18.1: Ramanathapuram Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	4232	4232	4232	4232	4232	4232	4104	4104	4104
VDF	0	0	0	0	0	1	0	0	0
MDF	101	103	76	80	82	33	25	23.84	23.84
OF	134	136	197	205	221	191	239	233.11	227.65
TFCA	235	239	273	285	303	225	264	256.95	251.49
Percent	5.55	5.65	6.45	6.73	7.16	5.32	6.43	6.26	6.13
Change	18	0	-6	0	18	-78	5	-7.05	-5.46
Scrub	23.5	15	4	4	6	2	1	0.88	6.25

Figure 8.18.1. Trend analysis of forest in Ramanathapuram district

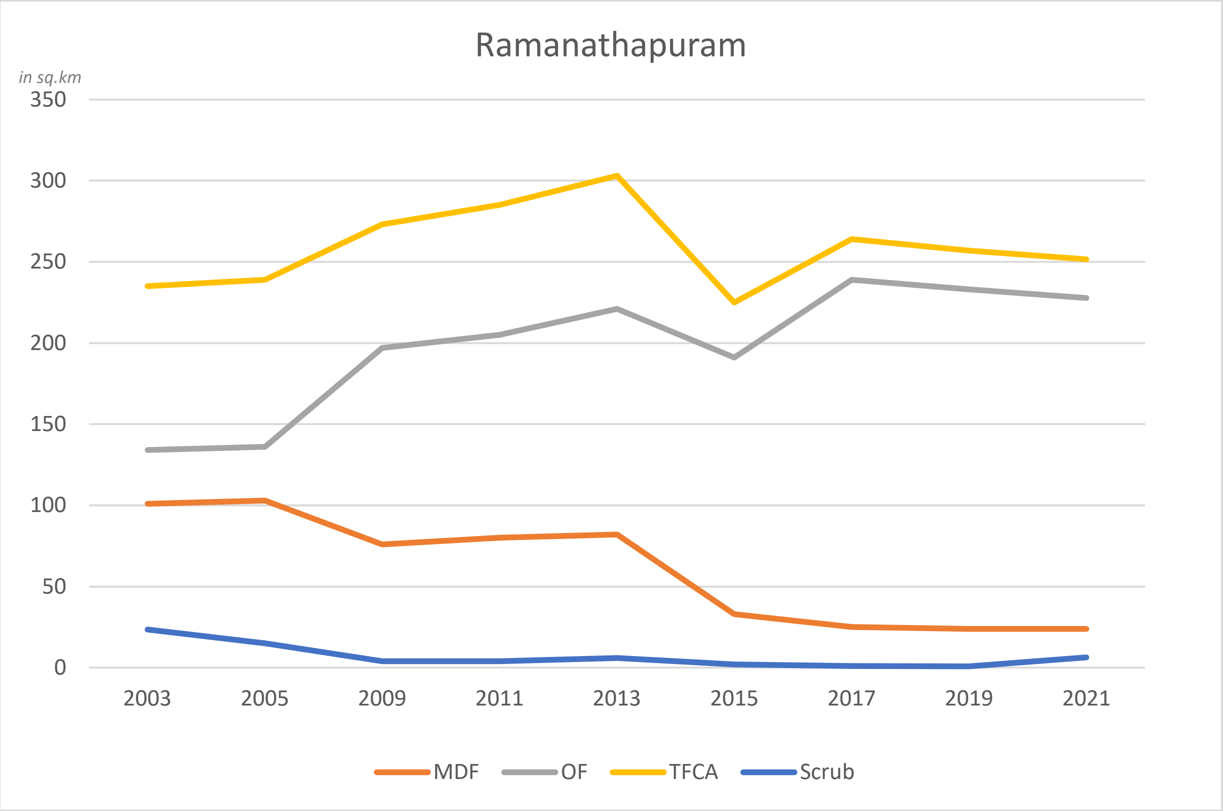


Figure 8.18.2. Share of Forest & non-forest area in Ramanathapuram district (2021)

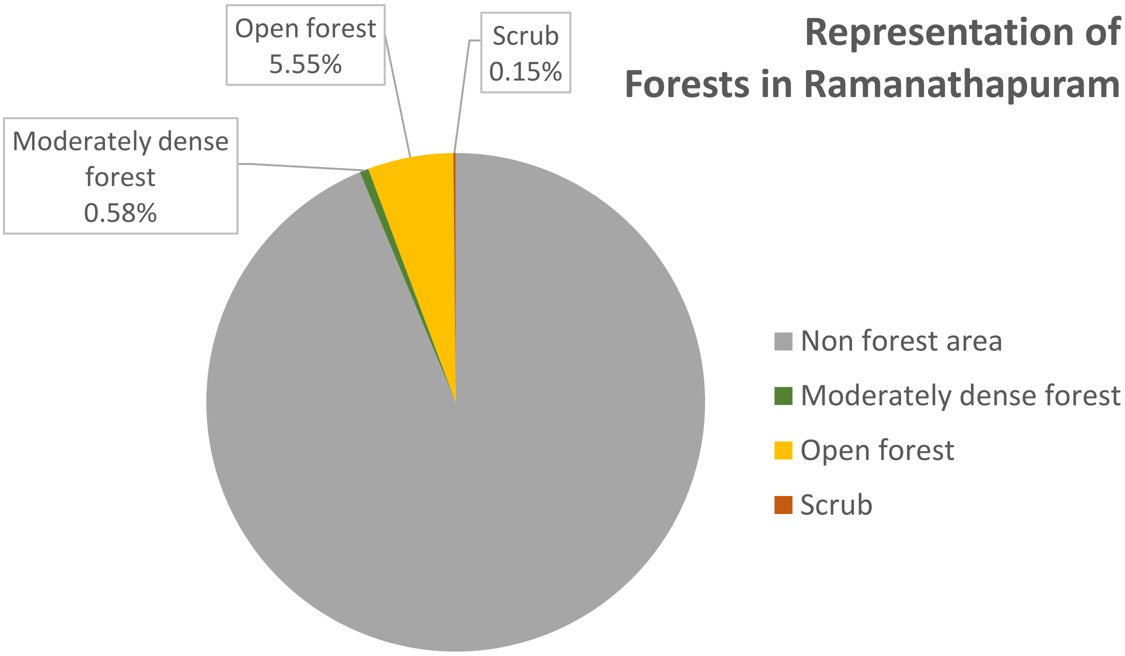


Figure 8.18.3. Forest Cover map of Ramanathapuram district

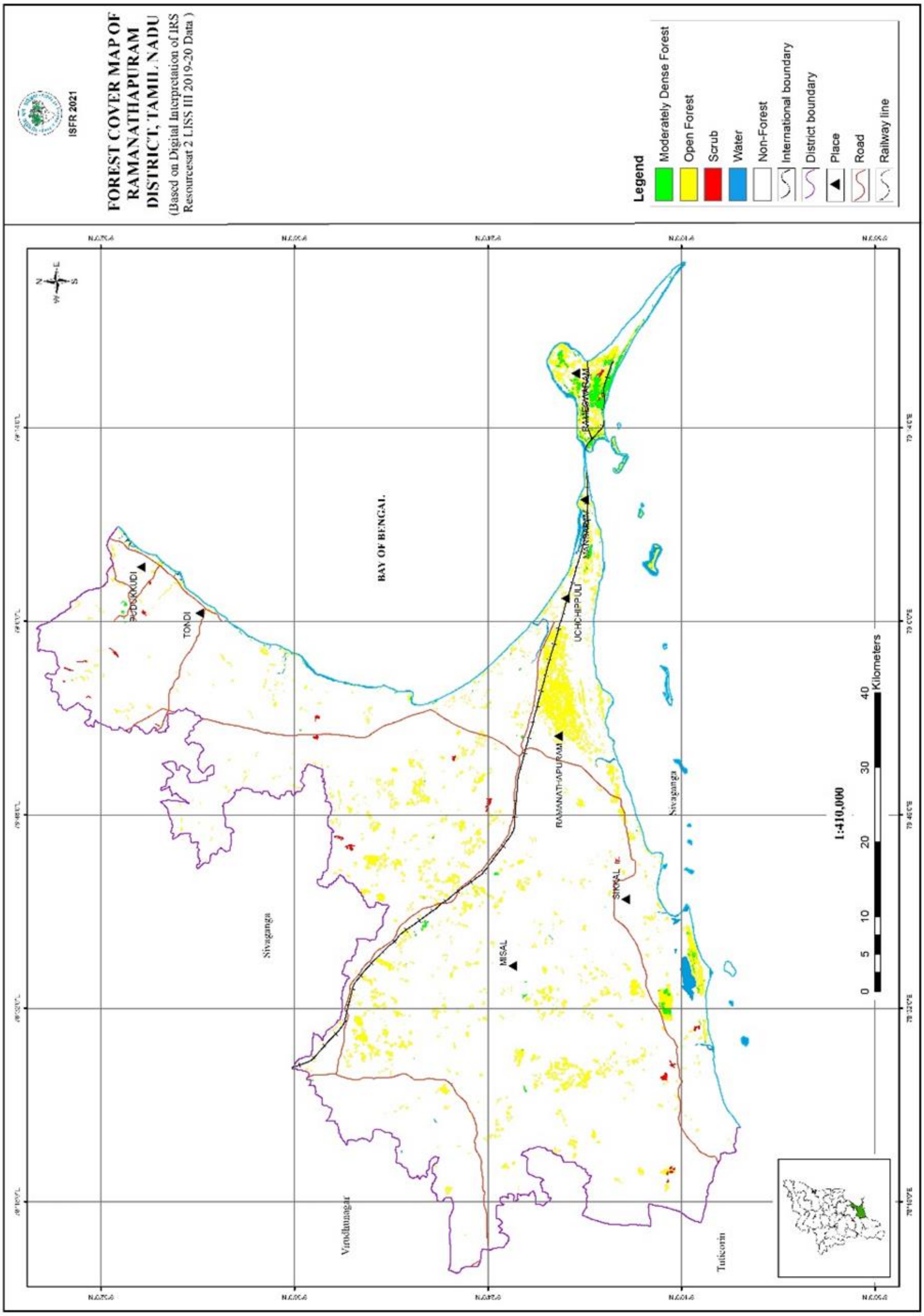
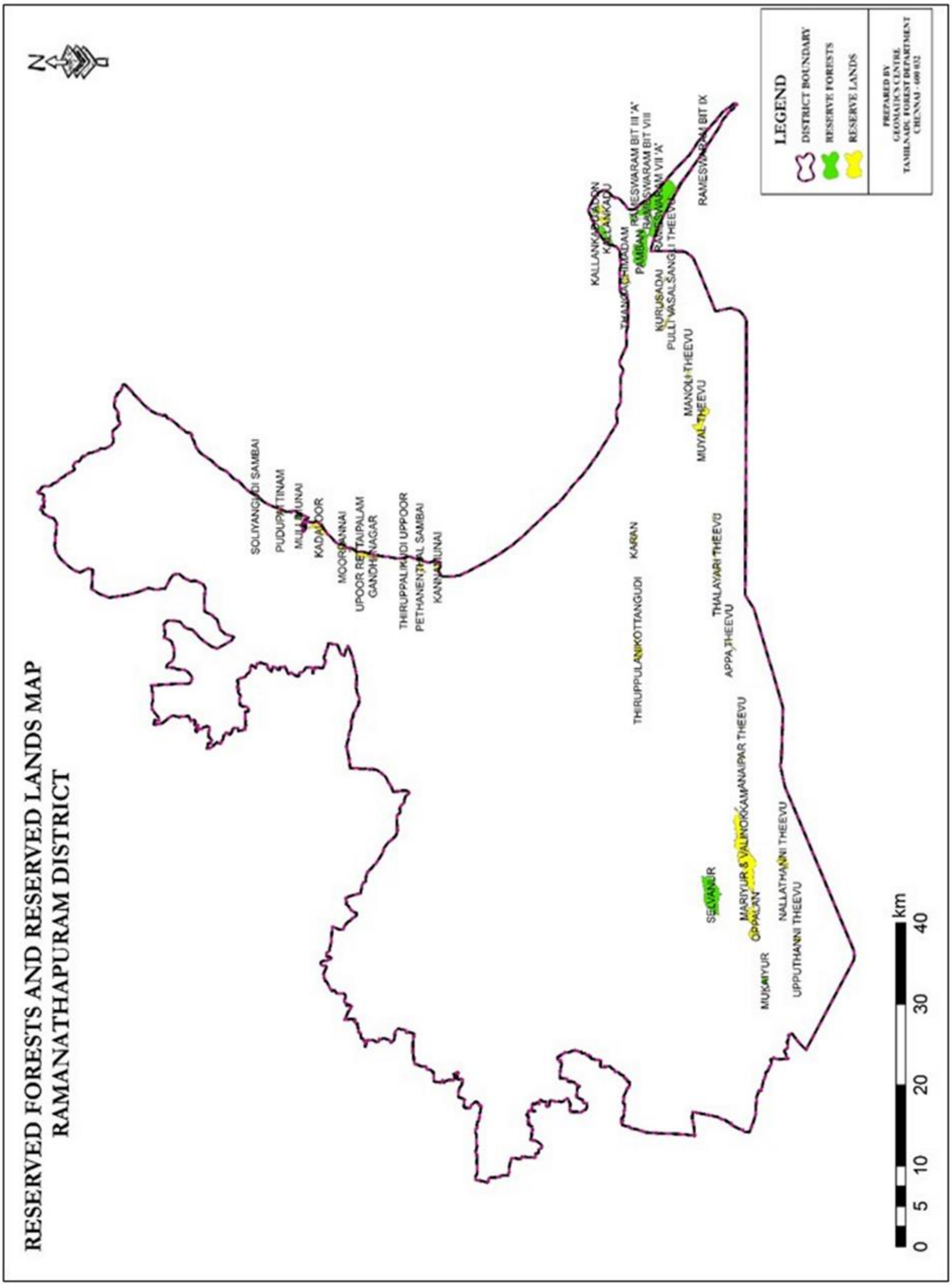


Figure 8.18.4. Map of Notified forests in Ramanathapuram district



19. SALEM

Salem district has a total geographical area of 5,237 square kilometers. The total forest cover area in Salem is about 1,417 sq.km. which constitutes 28.09% of the total geographical area. The total recorded forest area is 1284.35 sq.kms which includes 136 reserved forests (1154.95 square kilometers), 39 reserved lands (92.68 square kilometers), and the rest unclassified forest land. Salem district has all three types of density classes – Very dense, moderately dense and open forest.

The very dense forest of this district has seen a steady increase since 2003. From 67 sq.kms in 2003 the area increased to 197.62 sq.kms in 2021. This is a very good indicator for the forest management in this district. With respect to the Moderately dense forest, though there was a declining trend from 2003 to 2013, the area continued to increase thereafter with a steep rise from 479 sq.km in 2015 to 759 sq.km in 2017. But the open forest category was showing a declining trend. In the initial years between 2003 to 2015, there was a sharp increase in the open forest, but it stared to decline steeply in 2017 where it was estimated to be 525 sq.kms, since then the open forest category is decreasing marginally till 2021. Despite all these fluctuations, the total forest cover area of Salem continued to increase from 1134 sq.kms to 1471.12 sq.kms during the period 2003 to 2021. The total forest cover area of the district showed an increasing trend from 2003, but there was a decreasing trend from 2019; in that year, it lost 13.16 square kilometres of TFCA. This district has a very large area of moderate and open forest, by improving their density, the quality of the forest will improve and would contribute to the raise in the area of dense forest category.

Table 8.19.1: Salem Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	5235	5235	5235	5235	5235	5235	5237	5237	5237
VDF	67	67	139	139	139	130	199	198.62	197.62
MDF	528	529	422	422	423	479	759	756.76	757.2
OF	539	551	657	669	673	826	525	514.46	516.3
TFCA	1134	1147	1218	1230	1235	1435	1483	1469.84	1471.12
Percent	21.66	21.91	23.27	23.5	23.59	27.41	28.32	28.07	28.09
Change	30	0	0	13	5	200	46	-13.16	1.28
Scrub	106	189	79	68	96	23	31	33.64	33.83

Figure 8.19.1. Trend analysis of forest in Salem district

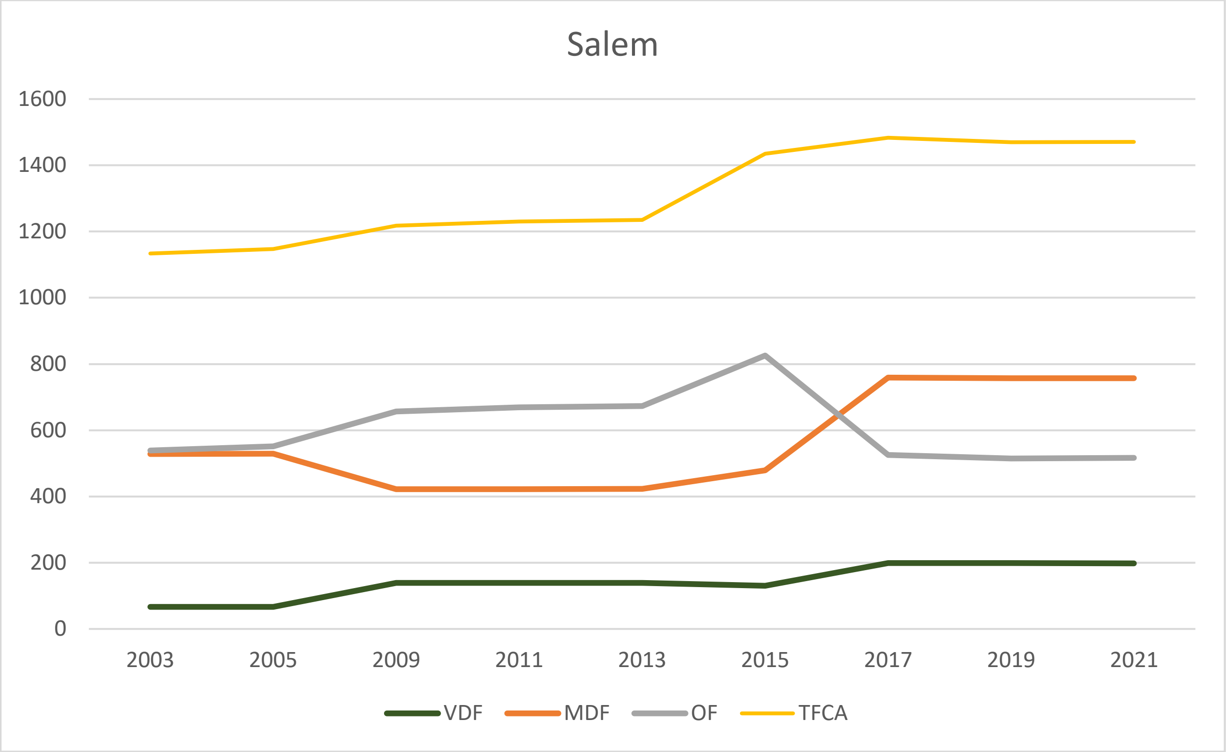


Figure 8.19.2. Share of Forest & non-forest area in Salem district (2021)

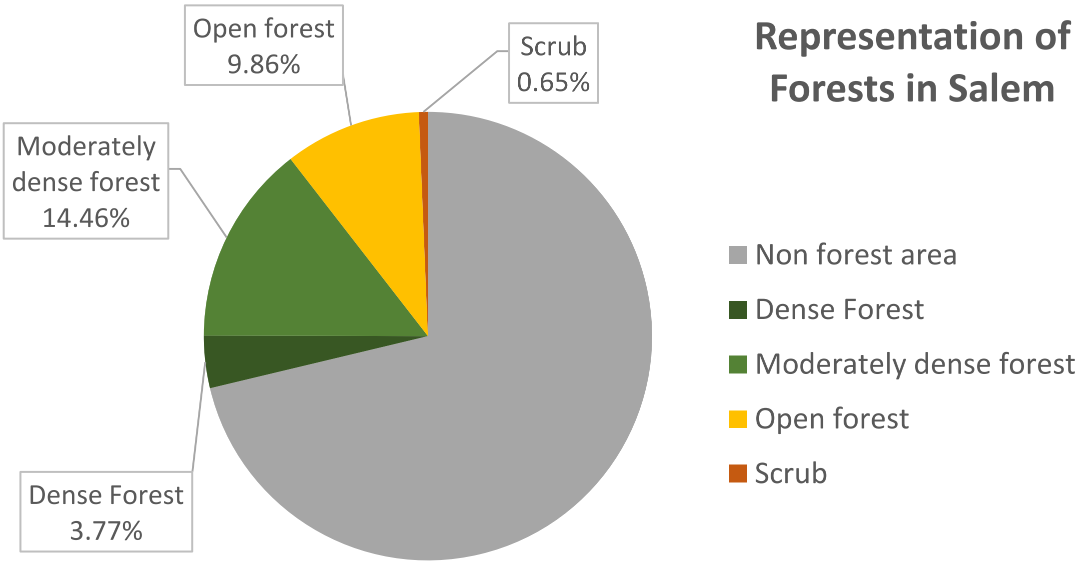


Figure 8.19.3. Forest Cover map of Salem district

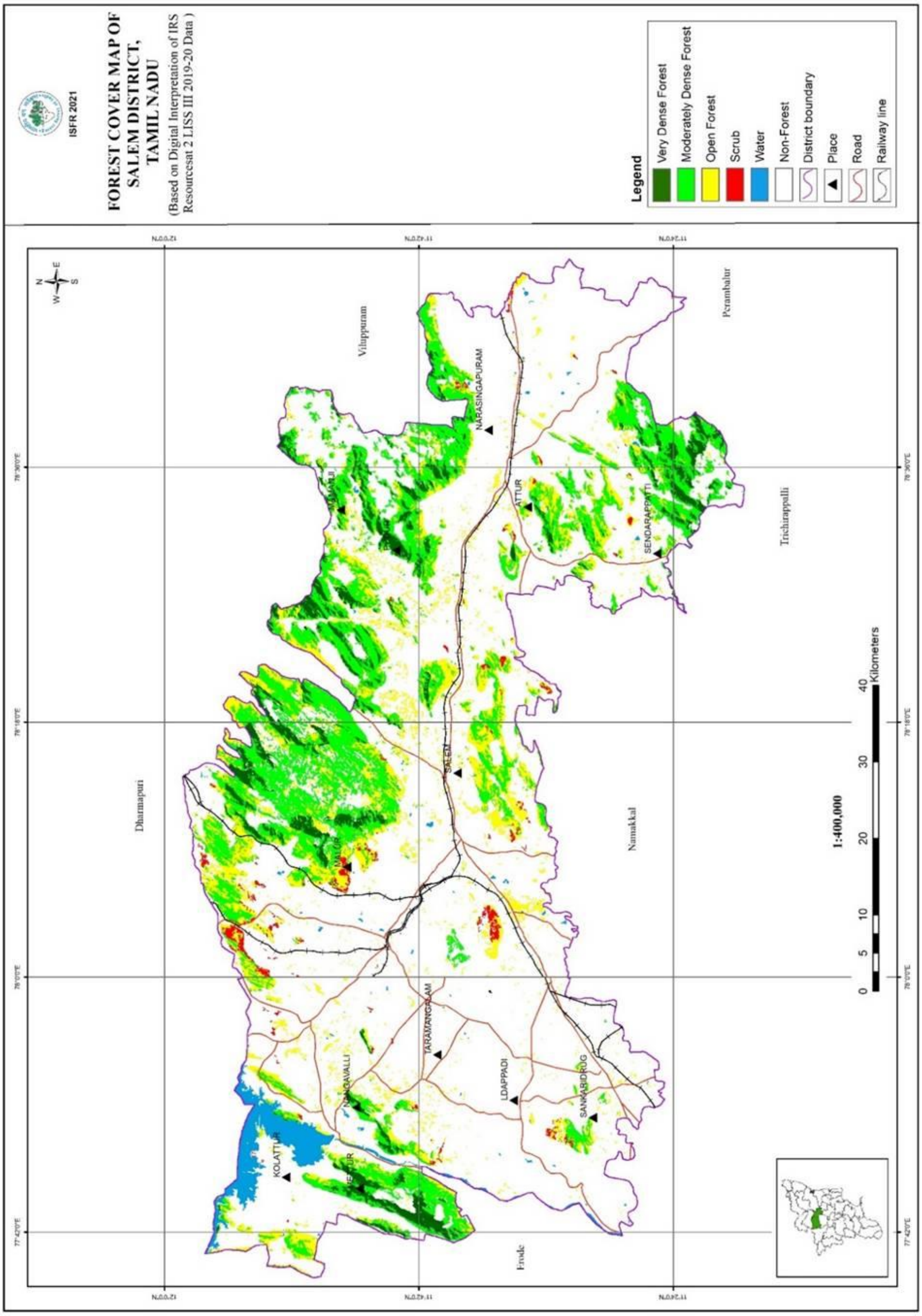
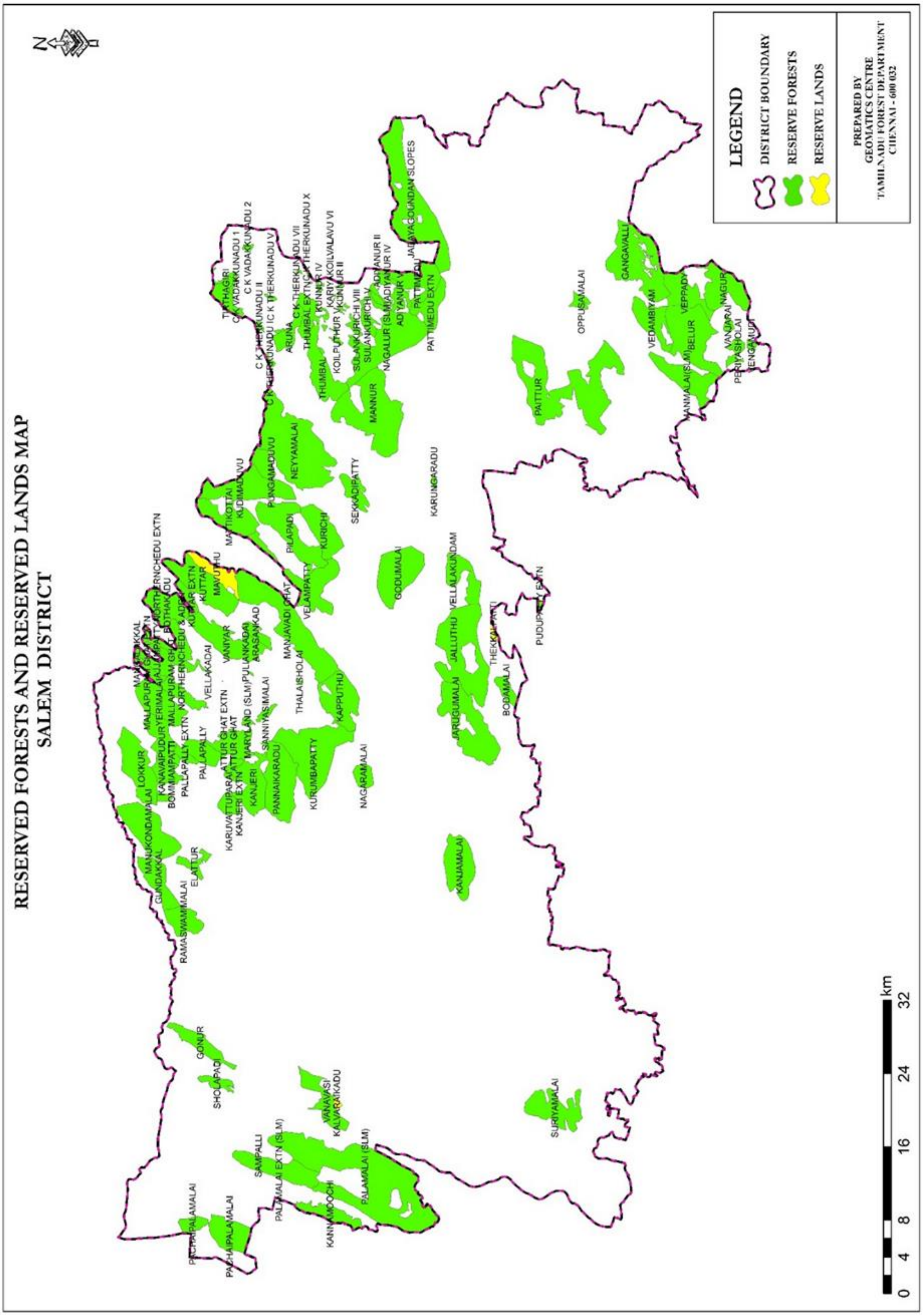


Figure 8.19.4. Map of Notified forests in Salem district



20. SIVAGANGAI

Sivagangai district, which is adjacent to Madurai also experiences extreme weather condition because of its interior location away from the coast and the western ghats. Total geographical area of this district was 4,233 sq.km. Within that 331.09 sq.km. is estimated as the total forest cover area that constitutes 7.82% of the total area. The total recorded forest area of Sivagangai district is 239 sq.km which includes 98 reserved forests (covering 156.56 sq.km.), 26 reserved land (41.24 sq.km.) and remaining 41.24 sq.km is unclassified land.

Dense forest is absent in Sivagangai. The area of the Moderately dense Forest class has continuously decreased since 2005, losing about 142.4 sq.km. in total. Open forest area shows fluctuating trend with decrease in area initially till 2013 and increased sharply in 2015. Further it started to decline marginally. Total forest cover area has largely reduced from 478 sq.km. in 2003 to 331.1 sq.km. in 2021. Though both the moderate forest and open forest has recorded a loss in the area, moderate forest contributes more to the loss of TFCA. The forest cover percentage of the district has decreased from 11.7% to 7.82%. One of the reasons for this loss can possibly be the effect of climate change induced by temperature variations and low rainfall. This has also affected the scrub land and resulted in variations. Since 2003, scrub land has decreased until 2017 and has reached 5.34 sq.km. in 2021.

Table 8.20.1: Sivagangai Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	4086	4086	4086	4086	4086	4086	4233	4233	4233
VDF	0	0	0	0	0	0	0	0	0
MDF	169	180	86	86	70	55	44	42.32	37.6
OF	309	297	226	231	212	311	300	287.34	293.49
TFCA	478	477	312	317	282	366	344	329.66	331.09
Percent	11.7	11.67	7.64	7.76	6.9	8.96	8.13	7.79	7.82
Change	-2	1	-1	-15	-35	84	35	-14.34	1.43
Scrub	38	19	17	17	12	2	3	5.34	5.34

Figure 8.20.1. Trend analysis of forest in Sivagangai district

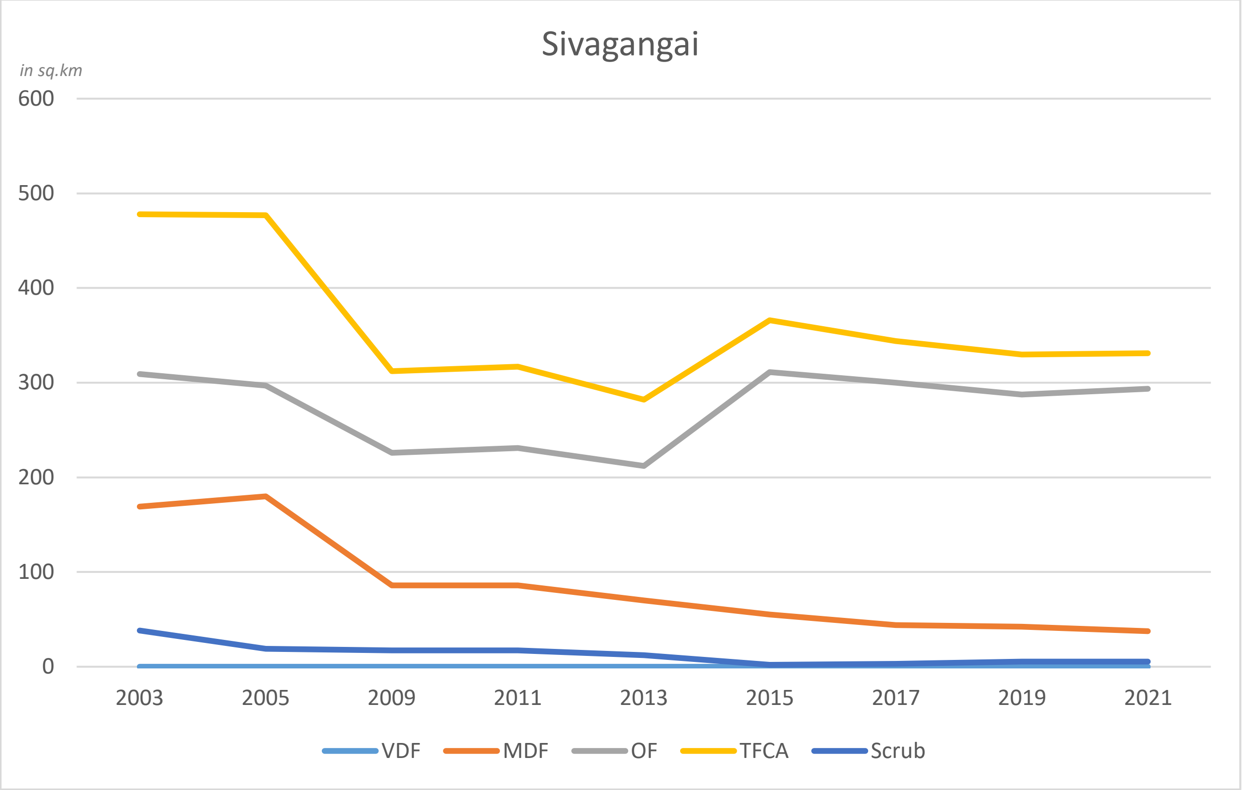


Figure 8.20.2. Share of Forest & non-forest area in Sivagangai district (2021)

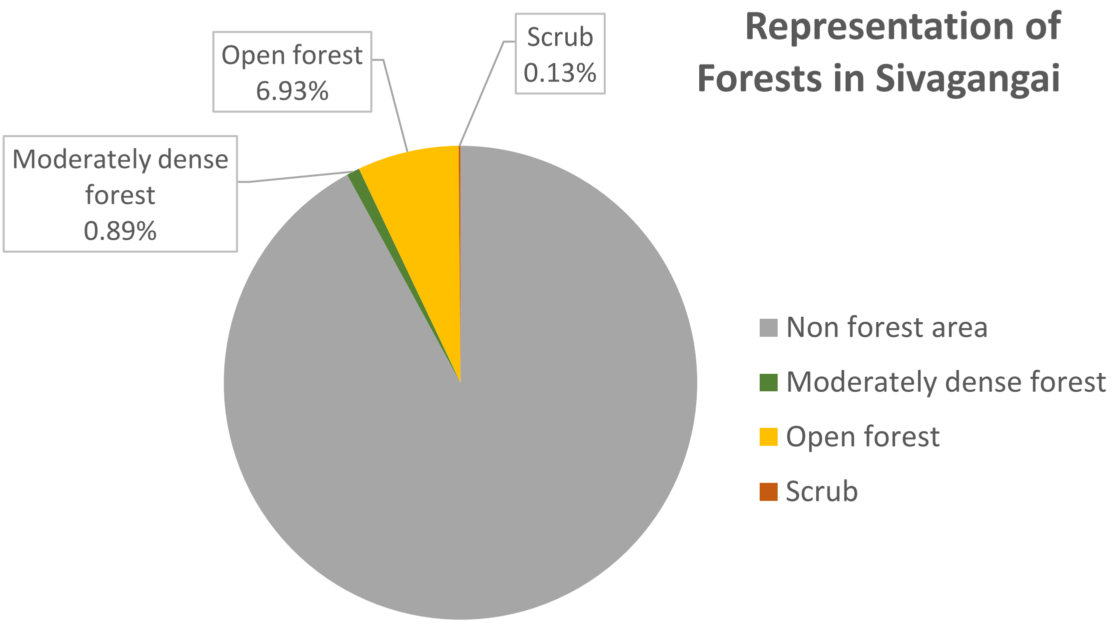


Figure 8.20.3. Forest Cover map of Sivagangai district

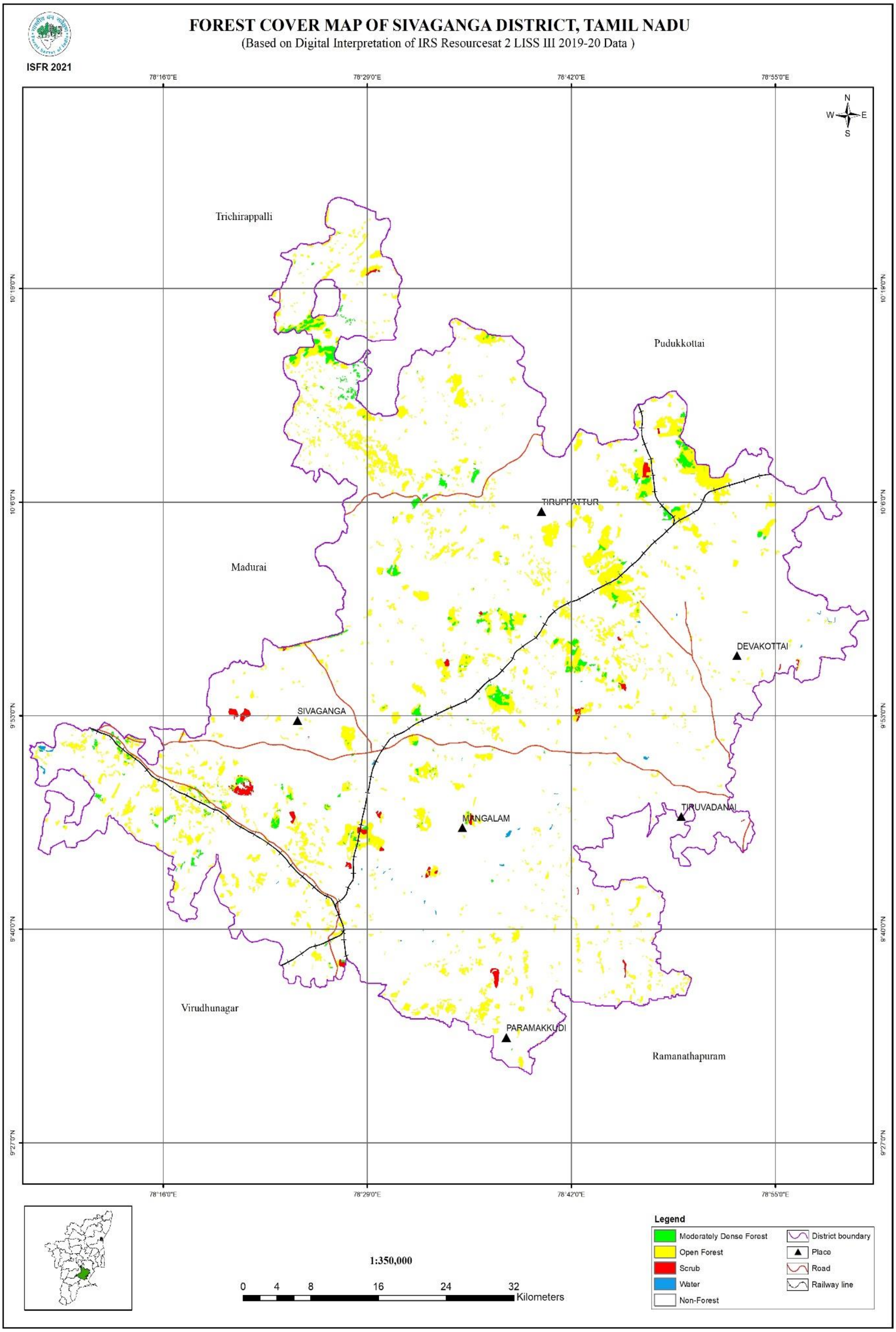
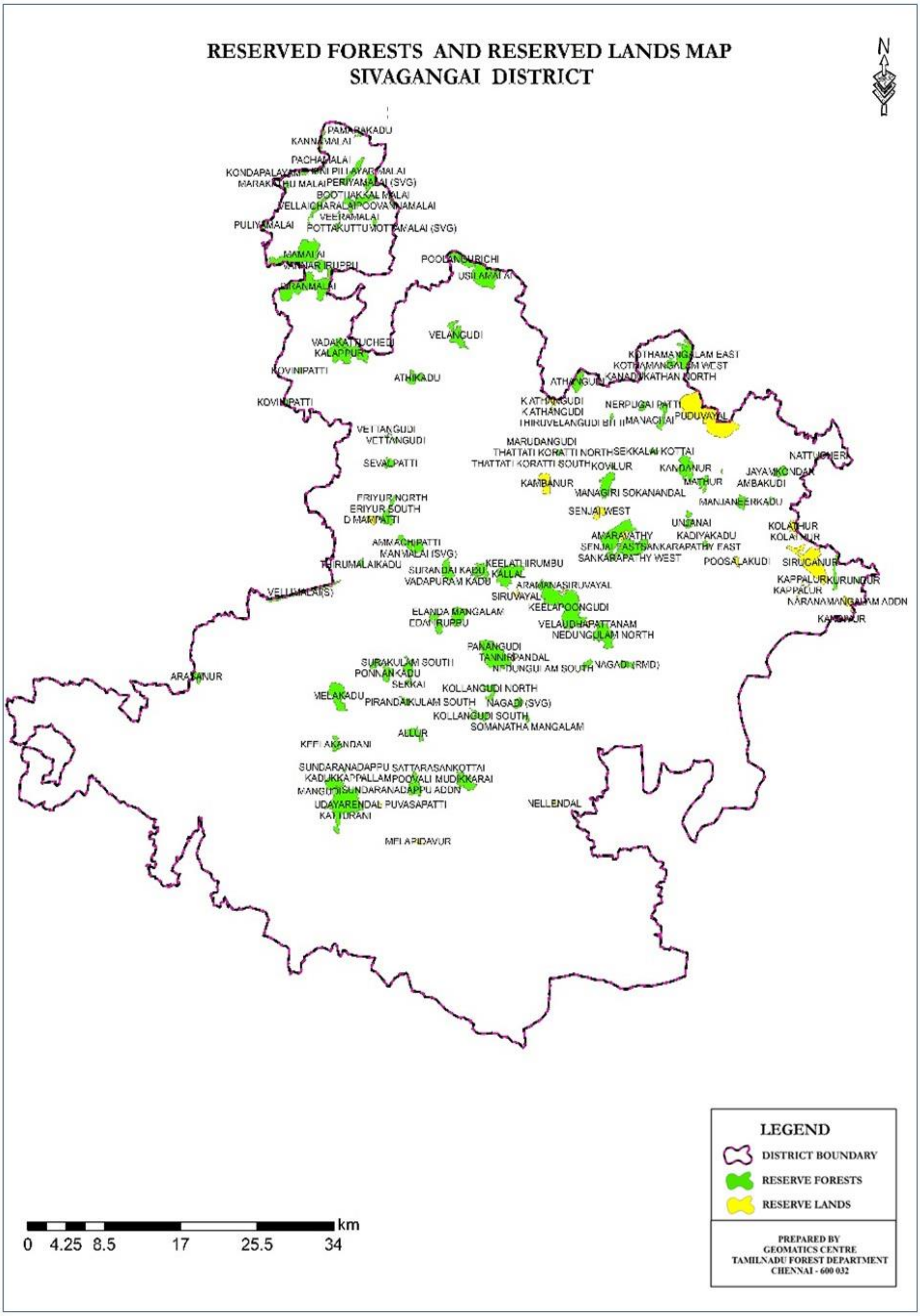


Figure 8.20.4. Map of Notified forests in Sivagangai district



21. THANJAVUR

Thanjavur district is primarily known for its cultural heritage and agricultural richness. While the district is not known for its dense forests, there are some small fragmented forested areas. The total recorded forest area here is 10.39 sq.km. There are 19 reserved forests and 2 reserved lands in this district. Only two density classes are available here – moderately dense forest with an area of 265 sq.km. and open forest with an area of 85.3 sq.km.

The total forest cover area has been increasing until 2015 and has recorded a sharp decrease between 2015 to 2017 and has not increased back to the level in 2015. During this period moderately dense forest has seen a sharper decline than the open forest category. In Thanjavur, agriculture being the most prominent economic activity, agro-forestry of short rotation trees could be tried out at larger scale through mass programs involving all stakeholders. Such a drive could help in creating integrated and sustainable agriculture farming models that will supplement the farmers' income. Efforts should be made to protect and preserve these small patches of fragmented forests, as they are important for the region's ecological balance.

Table 8.21.1: Thanjavur Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	3415	3415	3415	3415	3415	3415	3411	3411	3411
VDF	0	0	0	0	0	0	0	0	0
MDF	60	63	131	133	131	328	249	265.06	265.02
OF	69	75	52	62	61	108	107	81.13	85.32
TFCA	129	138	183	195	192	436	356	346.19	350.34
Percent	3.78	4.04	5.36	5.71	5.62	12.77	10.44	10.15	10.27
Change	59	0	4	13	-3	244	-22	-9.81	4.15
Scrub	41	4	0	0	0	0	0	0.33	0.64

Figure .21.1. Trend analysis of forest in Thanjavur district

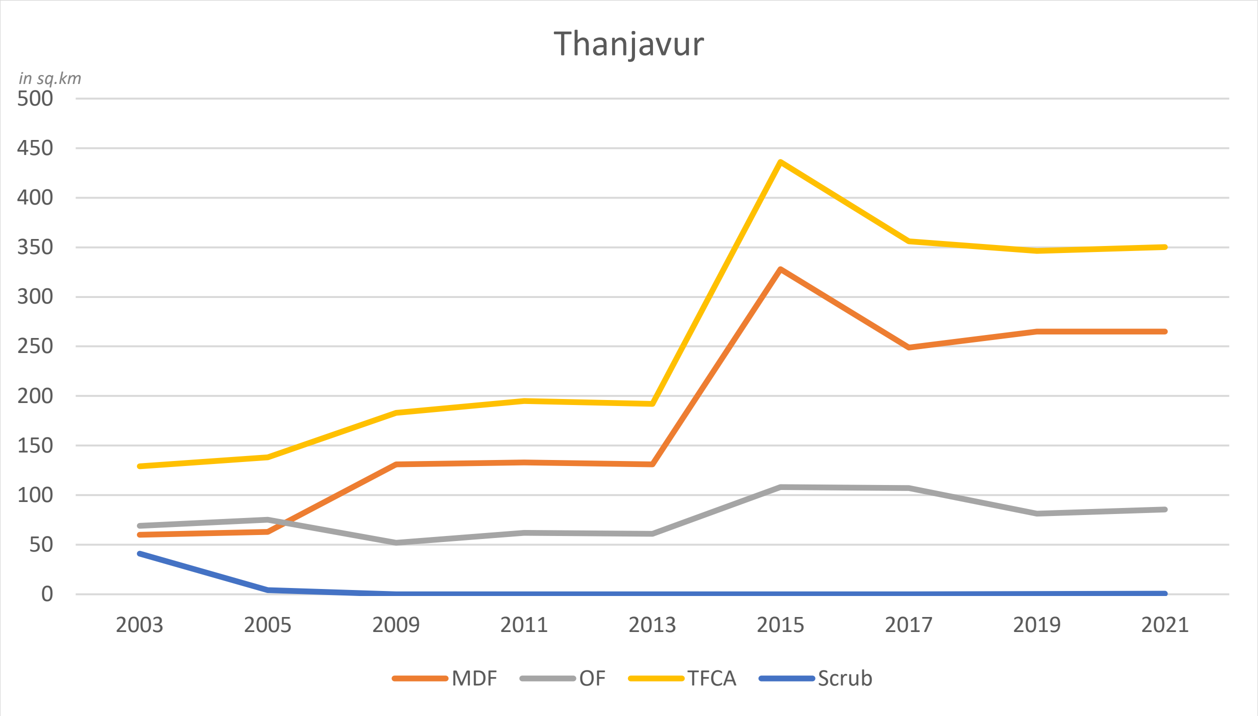


Figure 8.21.2. Share of Forest & non-forest area in Thanjavur district (2021)

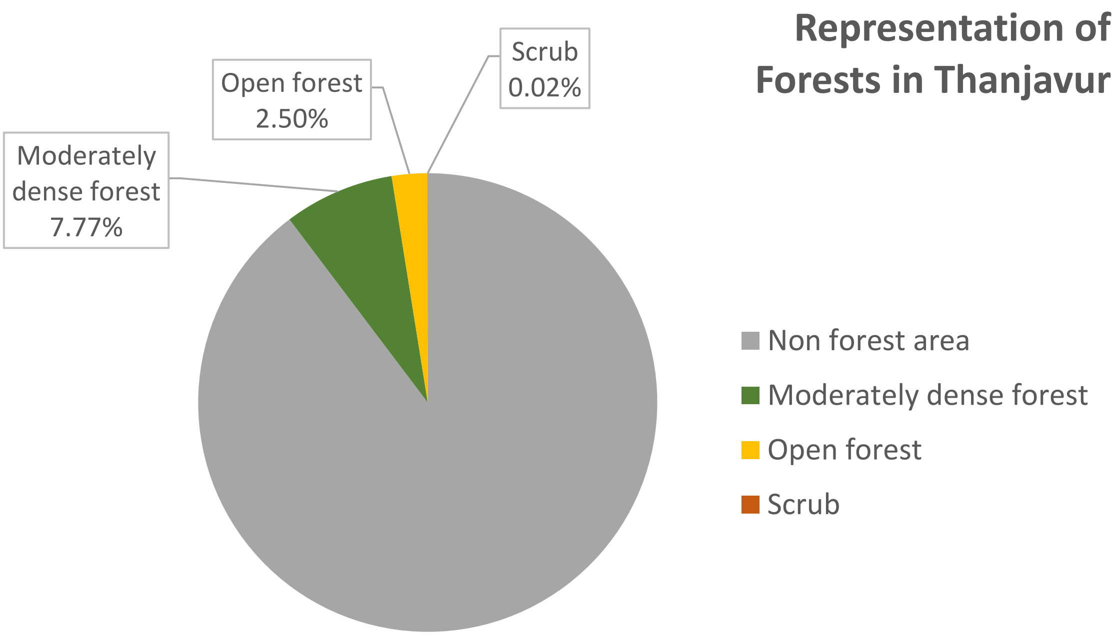


Figure 8.21.3. Forest Cover map of Thanjavur district

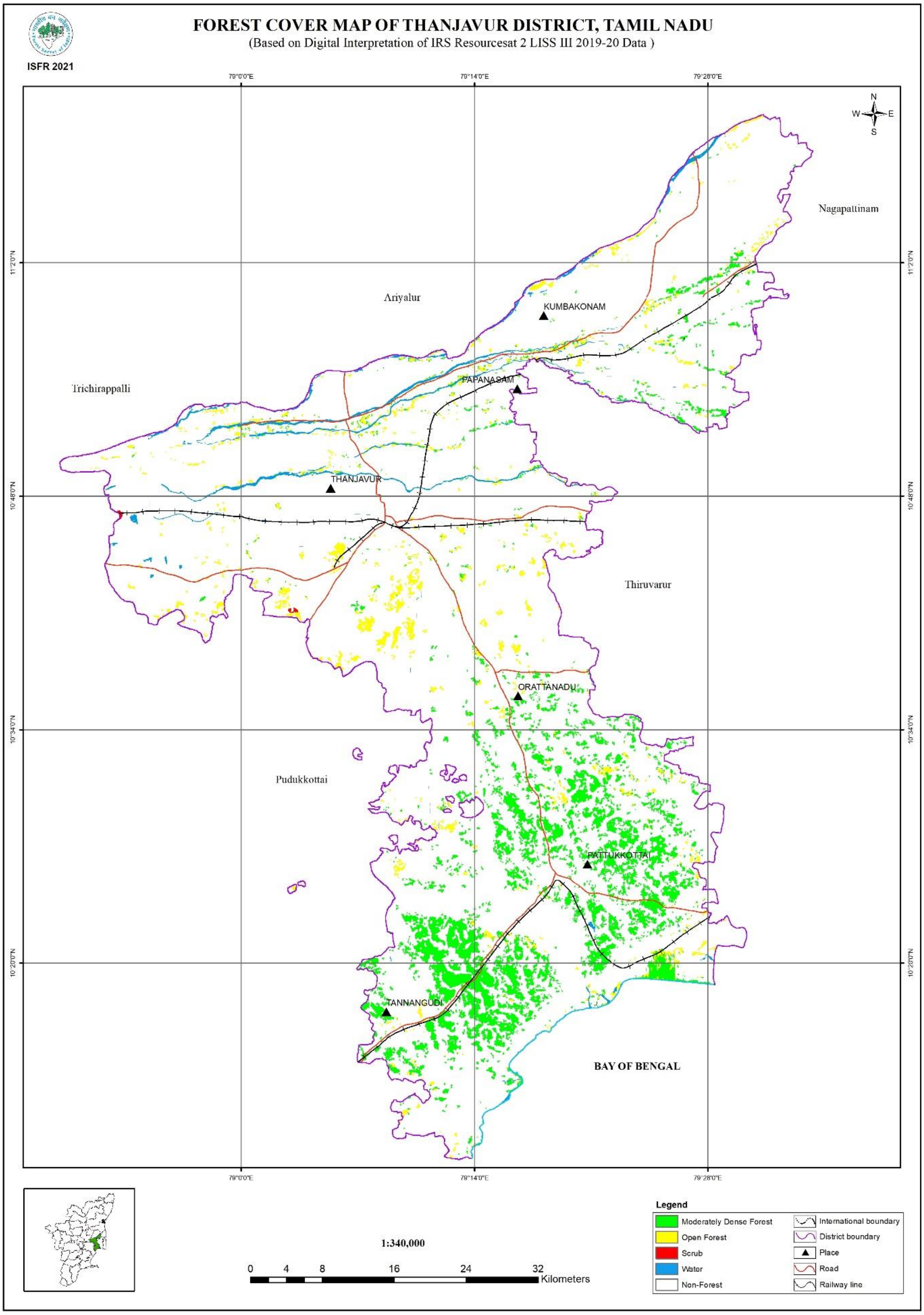
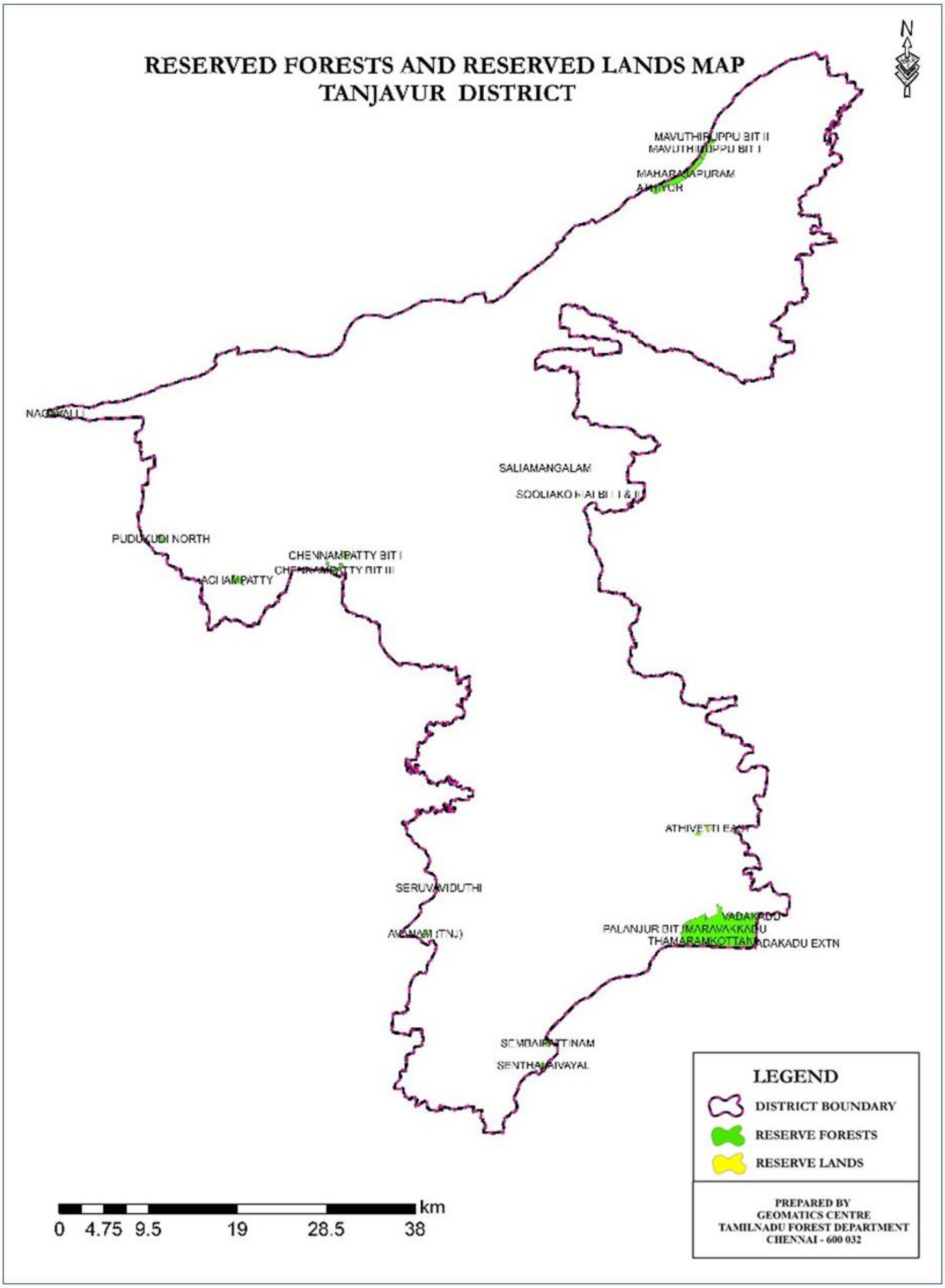


Figure 8.21.4. Map of Notified Forests in Thanjavur district



22. THE NILGIRIS

The Nilgiris district is home to a diverse range of flora and fauna. The district is known for its lush green forests that are spread across the Western Ghats Mountain range. Some of the prominent forests in the Nilgiris district are - Mudumalai National Park and Mukurthi National Park. Nilgiris Biosphere Reserve spans across the Nilgiris district and parts of the neighbouring states of Kerala and Karnataka. These forests not only provide habitat to a rich variety of flora and fauna but also play a crucial role in maintaining the ecological balance of the region.

According to the India State of Forest Report 2021, the total forest cover in the Nilgiris district of Tamil Nadu is 1731 square kilometers, which is approximately 67.5% of the district's total geographical area. The district has a mix of evergreen, semi-evergreen, and deciduous forests, which are spread across the Western Ghats Mountain range. There are 678 reserved forests and 104 reserved lands in this district which constitutes 1417.4 sq.km. of the recorded forest area while the remaining area of 314.9 sq.km. are various types of unclassified forest lands.

The forests of Nilgiris have three density classes – Very dense forest (17.96%), moderately dense forest (24.5%) and open forest (25%). The below table and the trend map clearly indicate that the total forest cover has been decreasing since 2015 at a considerable rate. This is a serious concern because the district is a habitat to large number of endangered flora and fauna species. In the recent years, the very dense forest class, the moderately dense and the open forest class are decreasing in area at a rapid rate. This trend is clearly not a healthy sign and special attention has to be taken to closely monitor this and to find the actual reason for this decrease. Possible reasons could be increasing anthropogenic pressure and developmental pressure on the forests and infestation of invasive alien species in large areas which has affected the quality of the forests in this district.

Table 8.22.1: The Nilgiris Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	2549	2549	2549	2549	2549	2549	2555	2565	2565
VDF	404	404	240	240	220	220	496	466.72	460.67
MDF	878	878	998	978	968	876	596	629.85	629.51
OF	789	789	810	868	899	757	627	634.44	641.2
TFCA	2071	2071	2048	2086	2087	1853	1719	1731.01	1731.38
Percent	81.25	81.25	80.35	81.84	81.88	72.7	67.02	67.49	67.5
Change	48	0	-1	-8	1	-234	-144	12.01	0.37
Scrub	14.5	2	0	0	0	0	4	6.85	8.71

Figure 8.22.1. Trend analysis of forest in Nilgiris

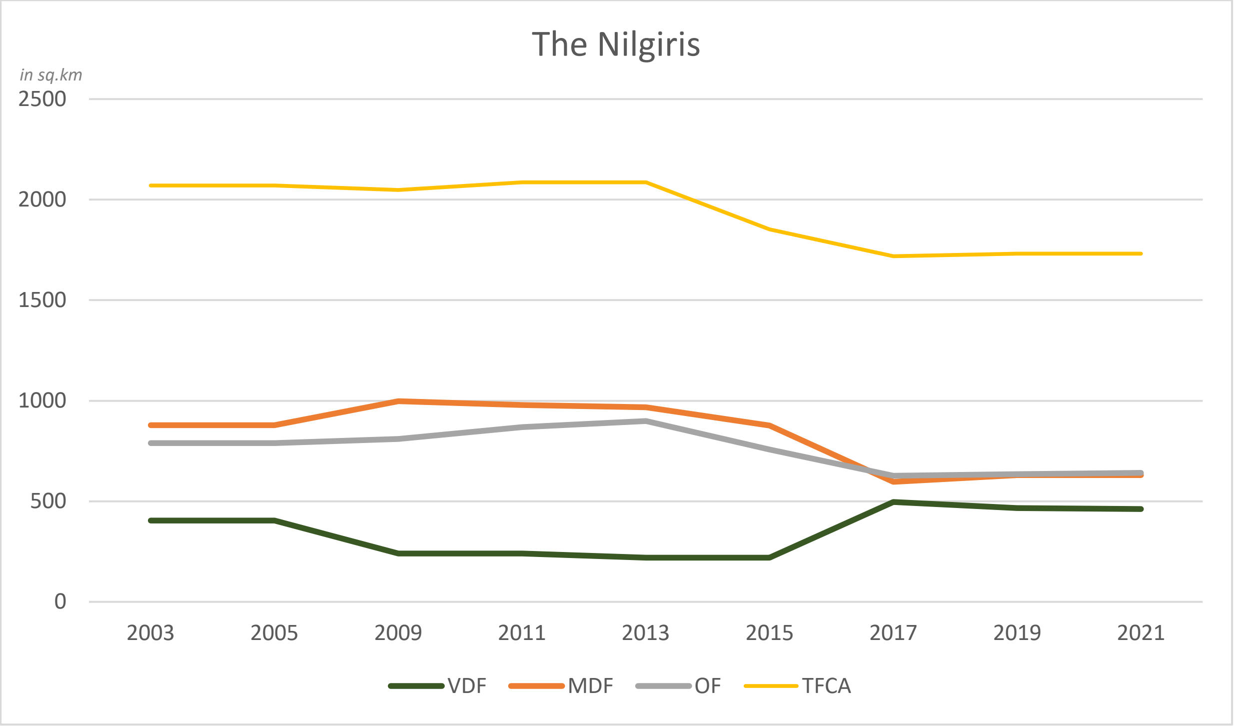


Figure 8.22.2. Share of Forest & non-forest area in Nilgiris district (2021)

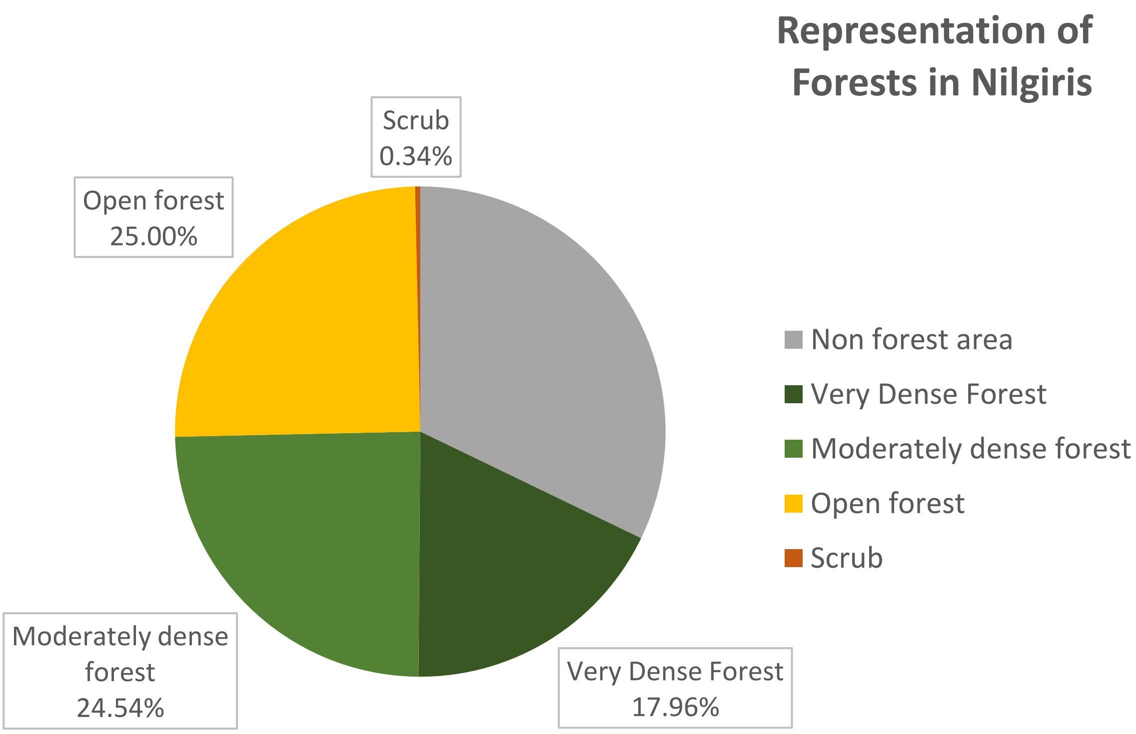


Figure 8.22.3. Forest Cover map of The Nilgiris district

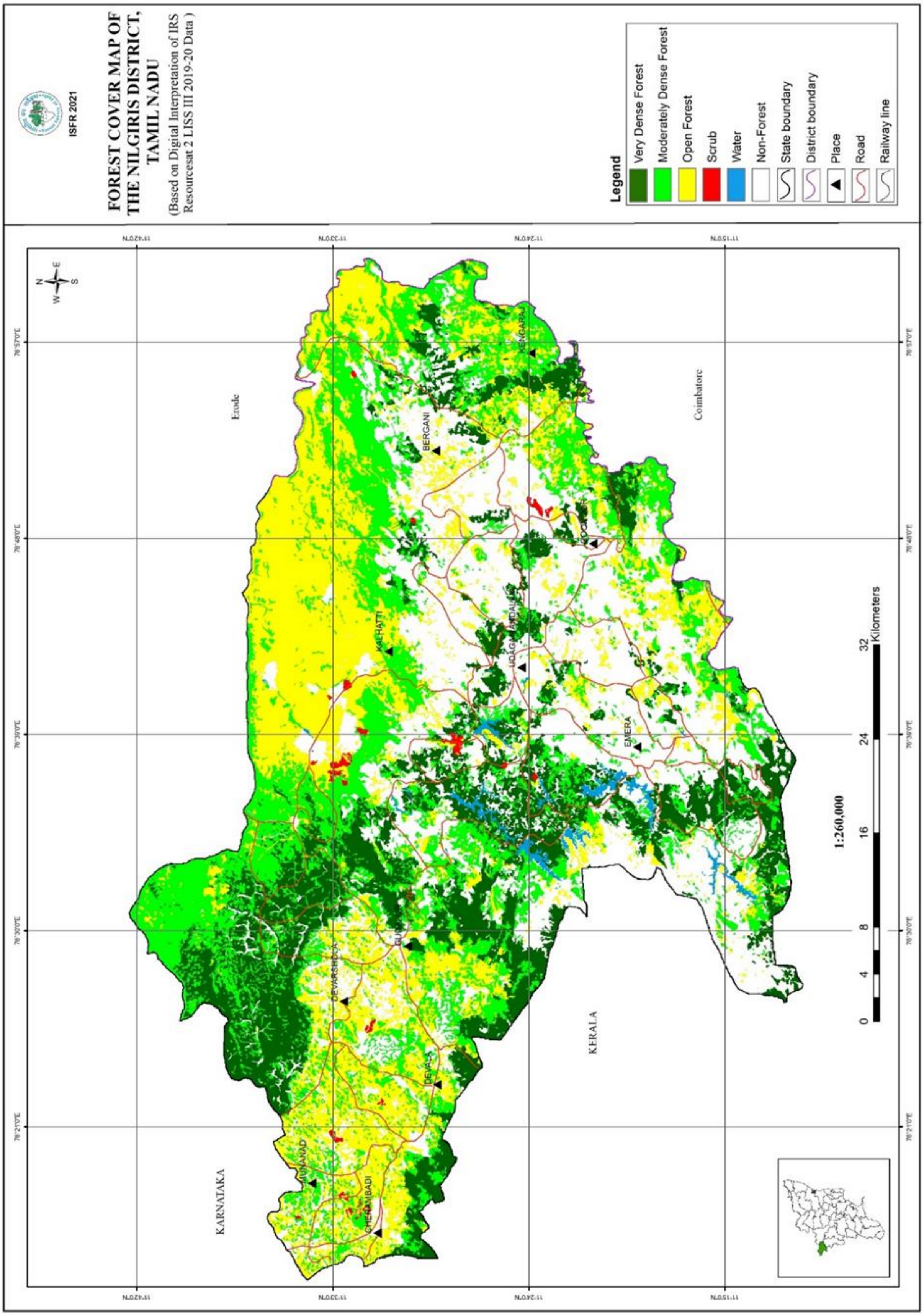
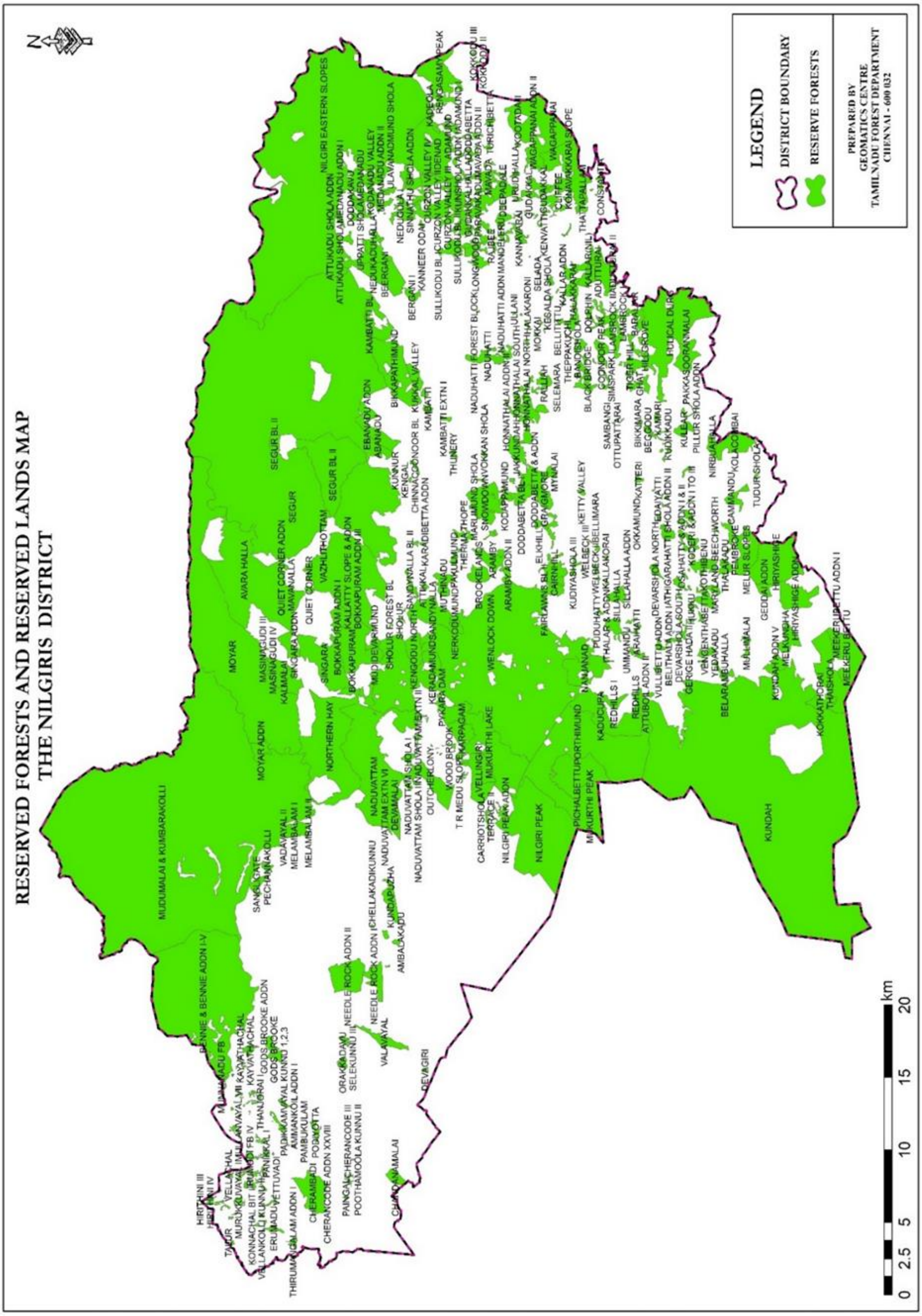


Figure 8.22.4. Map of Notified forests in Nilgiris district



23. THENI

Theni district is primarily known for its cultural heritage and agricultural richness. It has the Western Ghats range hence bestowed with rich biodiversity and beautiful landscapes. The total geographical area is 2686 sq.km. out of which the total forest cover area is estimated to be 1183.89 sq.km. The district has about 41.28% total forest cover which is more than 1/3 rd of the total geographical area. The total recorded forest area is 1168.74 sq.km. with about 93 research forests and 36 research lands.

Three forest density classes are available here – Very dense forest, moderately dense forest and open forest. The Very dense forest category has recorded an increase in the area on comparison of values between 2003 and 2021 which is about 89 sq.km. and 183.17 sq.km. respectively. Though there is an overall increase in the dense forest category, during the past two decades there has been a steady increase till 2015 with a value of 209 sq.km. and there after the dense forest area is decreasing. Moderately dense forest category had also increased in the area from 405 sq,km. (2003) to 471 sq.km. (2021), while the open forest has also increased considerably from 337 sq.km. (2003) to 529 sq.km. (2021).

As all the three forest cover classes have shown steady increase on average during the past two decades in Theni, the total forest cover area has also been increasing from 2003 till 2021. Theni district stands ahead of many other districts in Tamil Nadu with more than 41% of forest cover which is higher than the State Forest cover of 23.7%. Measures should be taken to maintain the green cover intact and at the same time protecting the interests of farmers and tribal people.

Table 8.23.1: Theni Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	2764	2764	2764	2764	2764	2764	2868	2868	2868
VDF	89	70	202	199	193	209	185	183.06	183.17
MDF	405	423	508	491	477	444	470	470.23	471.06
OF	337	362	298	271	278	474	522	522	529.66
TFCA	831	855	1008	961	948	1127	1177	1175.29	1183.89
Percent	30.07	30.93	36.47	34.77	34.3	40.77	41.04	40.98	41.28
Change	107	2	-3	-10	-13	179	36	-1.71	8.6
Scrub	80.5	134	64	63	78	6	29	29.36	29.42

Figure 8.23.1. Trend analysis of forest in Theni district

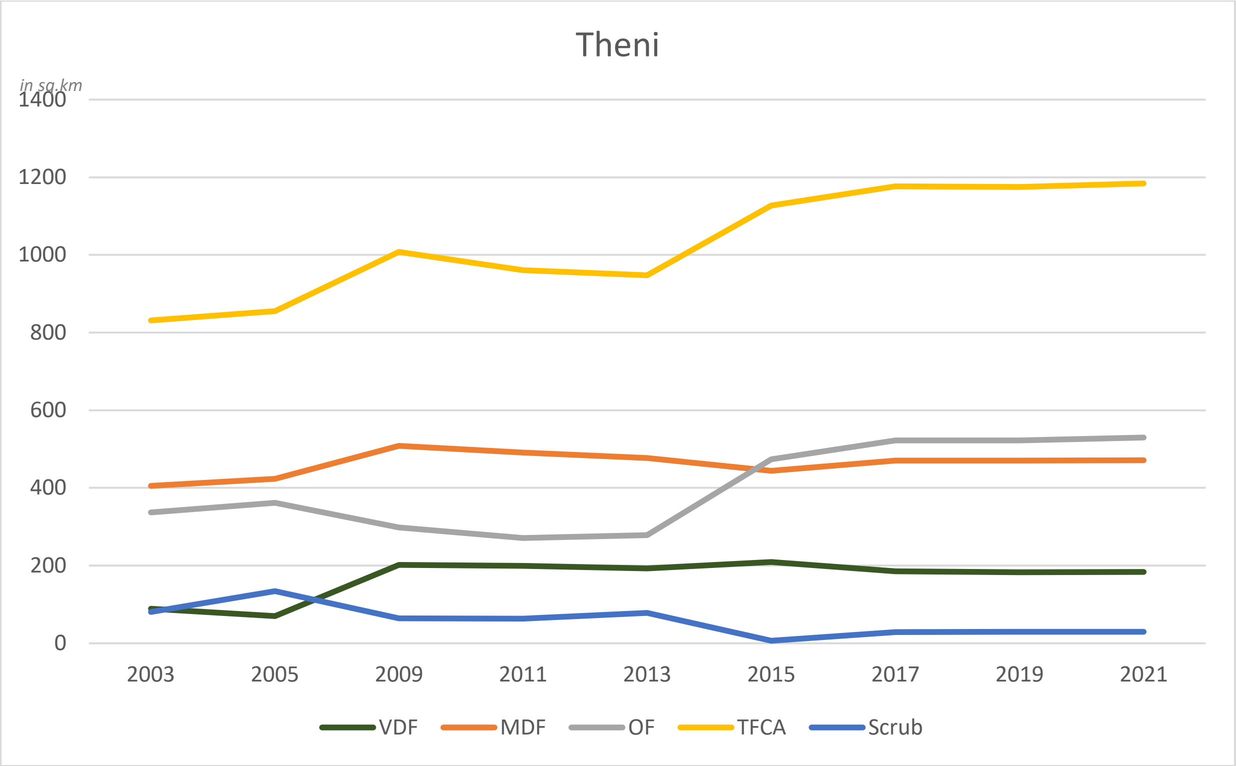


Figure 8.23.2. Share of Forest & non-forest area in Theni district (2021)

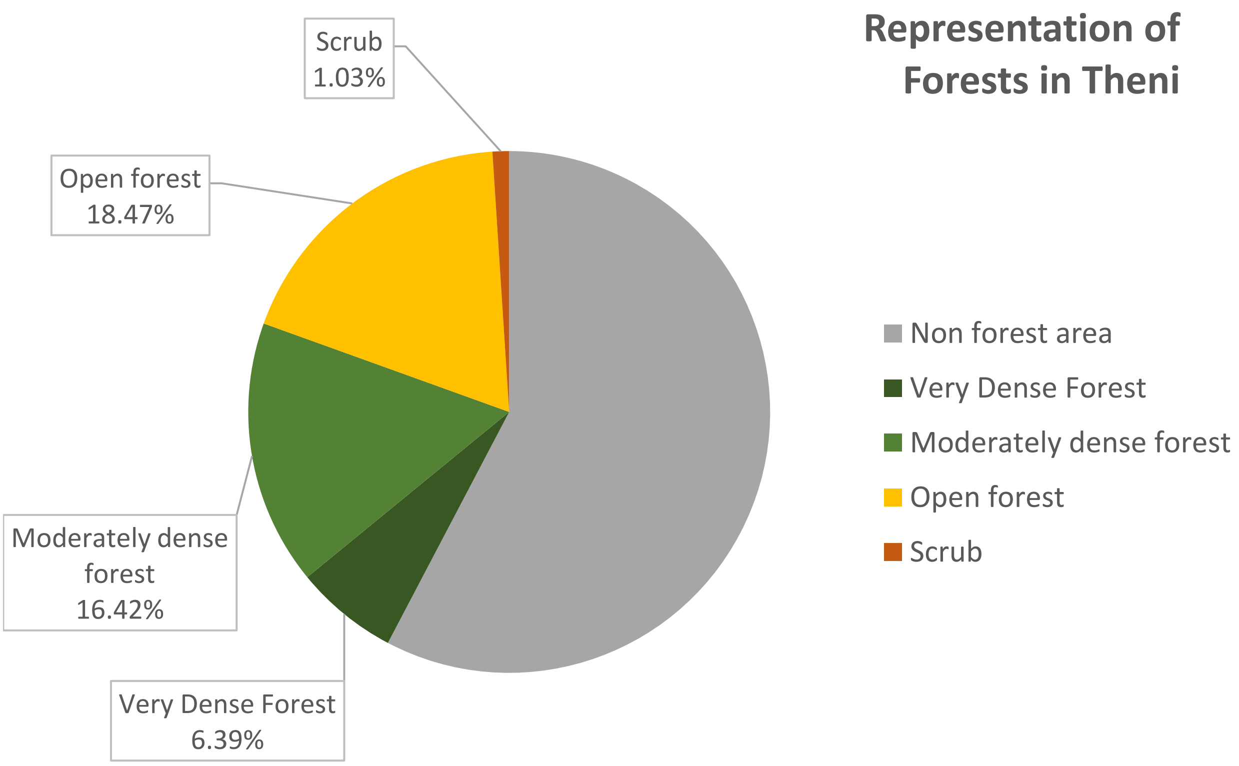


Figure 8.23.3. Forest Cover map of Theni district

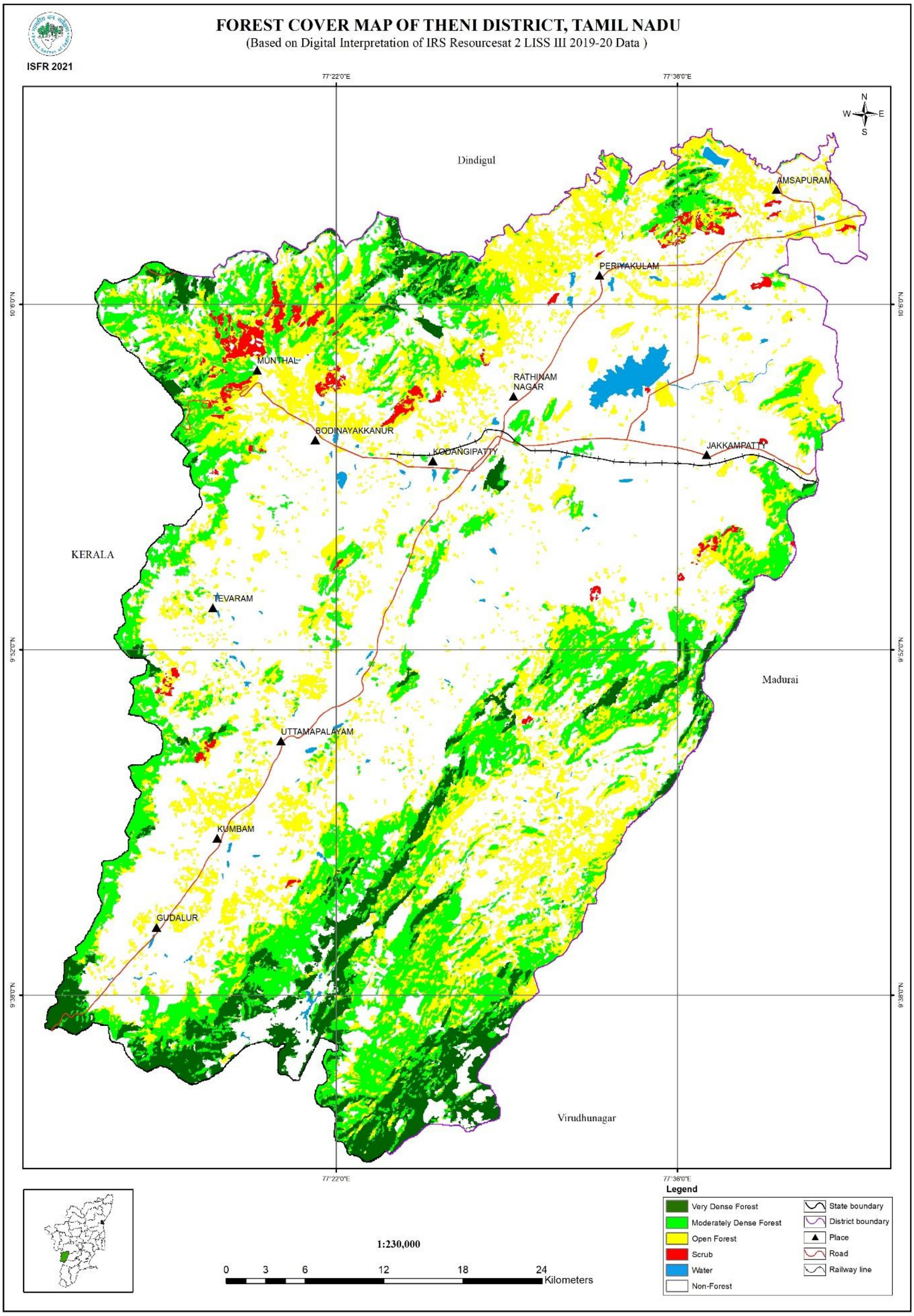
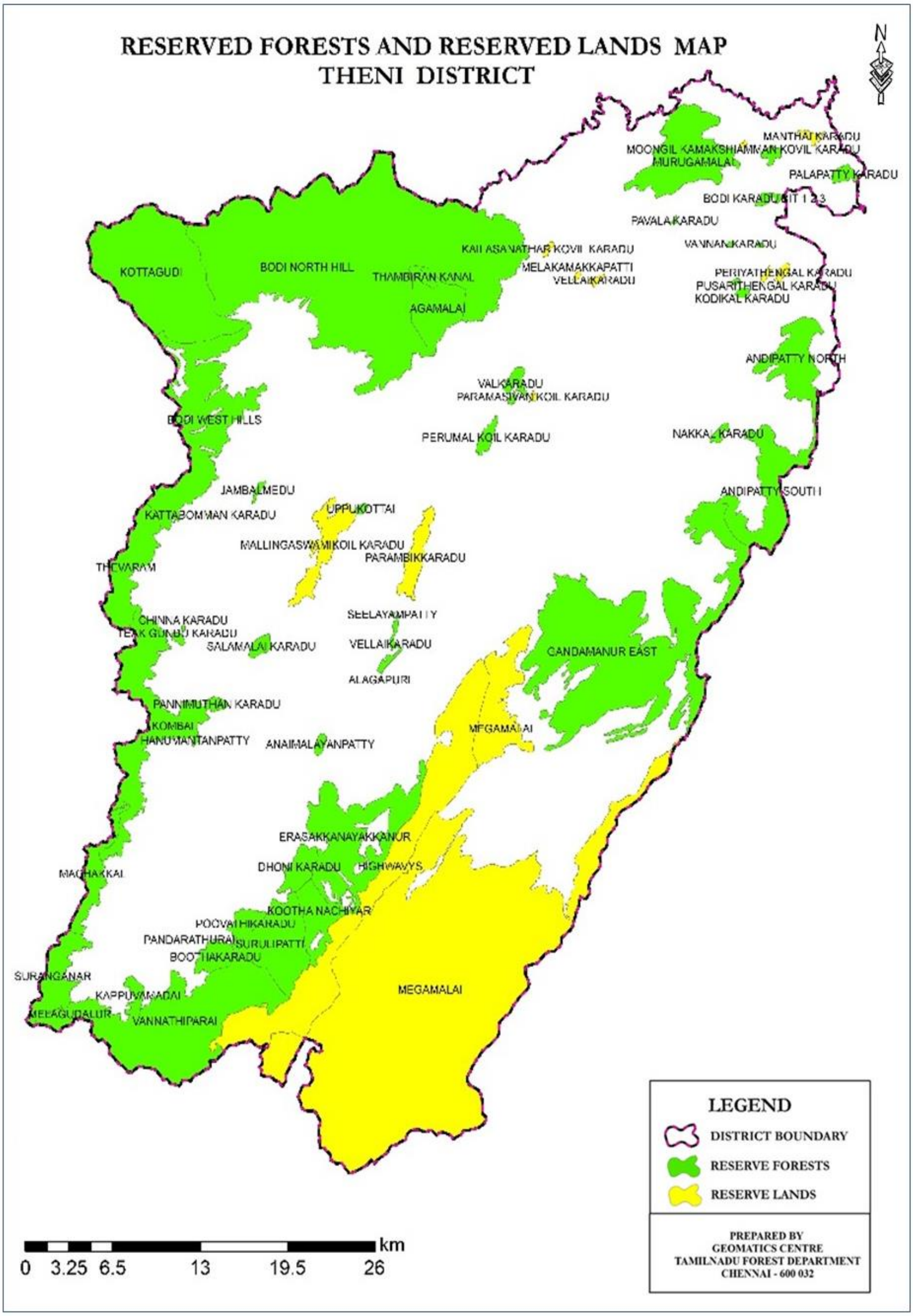


Figure 8.23.4. Map of Notified forests in Theni district



24. THIRUVALLUR

Thiruvallur district is located in the northern part of Tamil Nadu. The total geographical area is 3394 sq.km. out of which 295.52 sq.km. is the total forest cover area. The district has 8.71% of forest cover. The total recorded forest area is 201.78 sq.km. which includes 95 reserved forests and 15 reserved lands. The total forest cover area is more than the recorded forest area in this district which indicate that the tree outside forest contributes a good share to the district's green cover. Though Very dense forest category was estimated NIL in Thiruvallur until 2013, the conditions started to change from 2015 with 10 sq.km. of dense forest estimated for the first time. There after the value remains as 11 sq.km in three consecutive ISFR reports until 2021. The moderately dense forest has been continuously decreasing here from 2003 onwards. But the possibility that a portion of this category could have moved to the next density class i.e dense forest and some getting degraded to move into open forest category is also possible. The open forest constitutes 7% of the total geographical area. The estimated values of the open forest have been largely increasing, though it was decreasing in the initial few years. Finally, the total increase in the open forest category is about 88 sq.km. The total forest cover area has also increased considerably since 2003. As Thiruvallur is adjoining Chennai, the effect of the urbanization is very high in this district which poses threat to the existing forests and also increases the need for creating more urban green spaces. Additionally, the percentage of forest cover in Thiruvallur is also very less, so there is a need to increase the green cover by specialized schemes or measures. The availability of the scrublands gives a good opportunity to take up intensive tree planting in Thiruvallur.

Table 8.24.1: Thiruvallur Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	3413	3413	3413	3413	3413	3413	3394	3394	3394
VDF	0	0	0	0	0	10	11	11	11
MDF	62	62	59	59	59	46	48	45.87	46.1
OF	160	169	154	155	169	191	228	228.8	238.42
TFCA	222	231	213	214	228	247	287	285.67	295.52
Percent	6.5	6.77	6.24	6.27	6.68	7.24	8.46	8.42	8.71
Change	1	2	0	1	14	19	43	-1.33	9.85
Scrub	161	96	79	76	75	41	50	49.43	51.41

Figure 8.24.1. Trend analysis of district in Thiruvallur

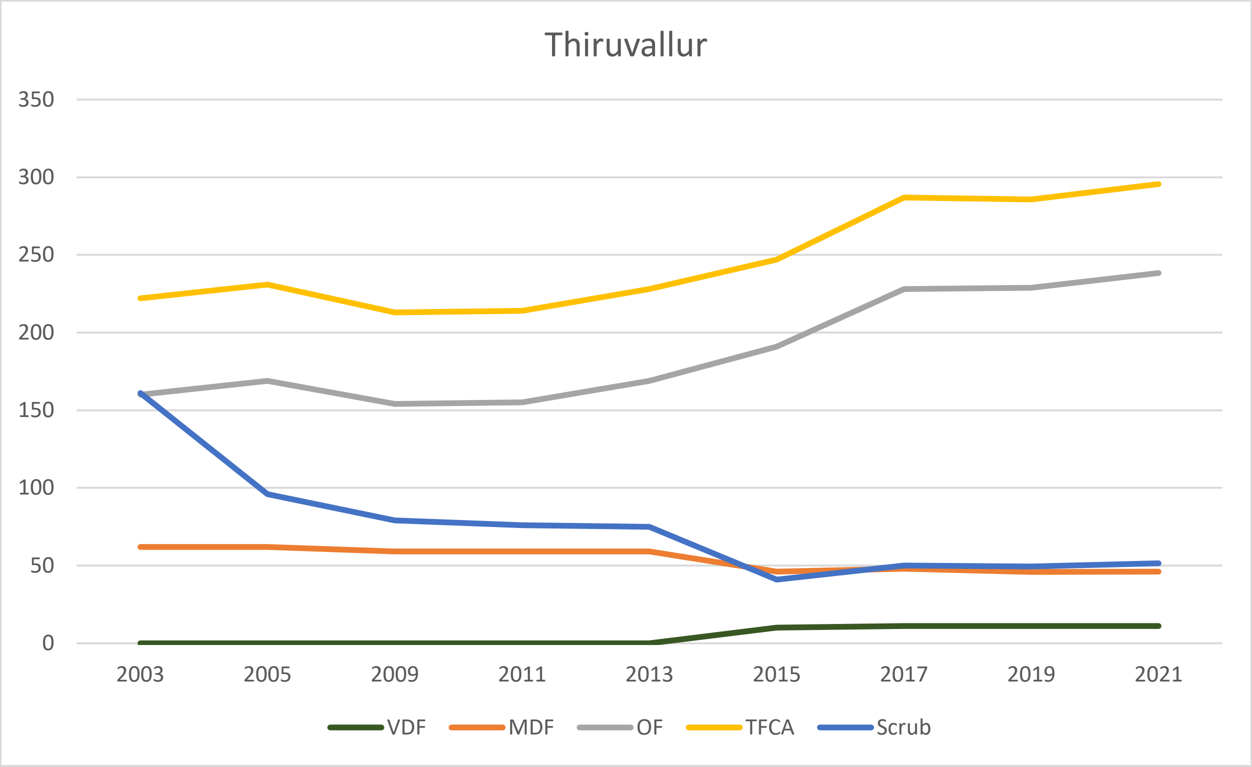


Figure 8.24.2. Share of Forest & non-forest area in Thiruvallur district (2021)

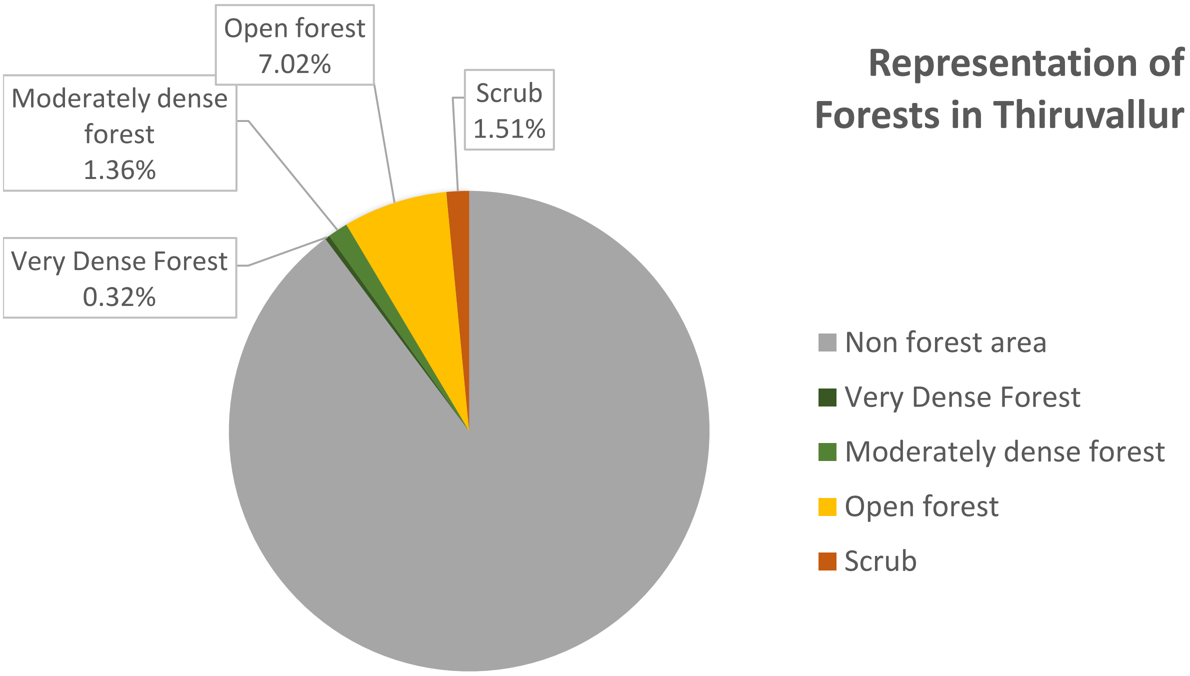


Figure 8.24.3. Forest Cover map of Thiruvallur district

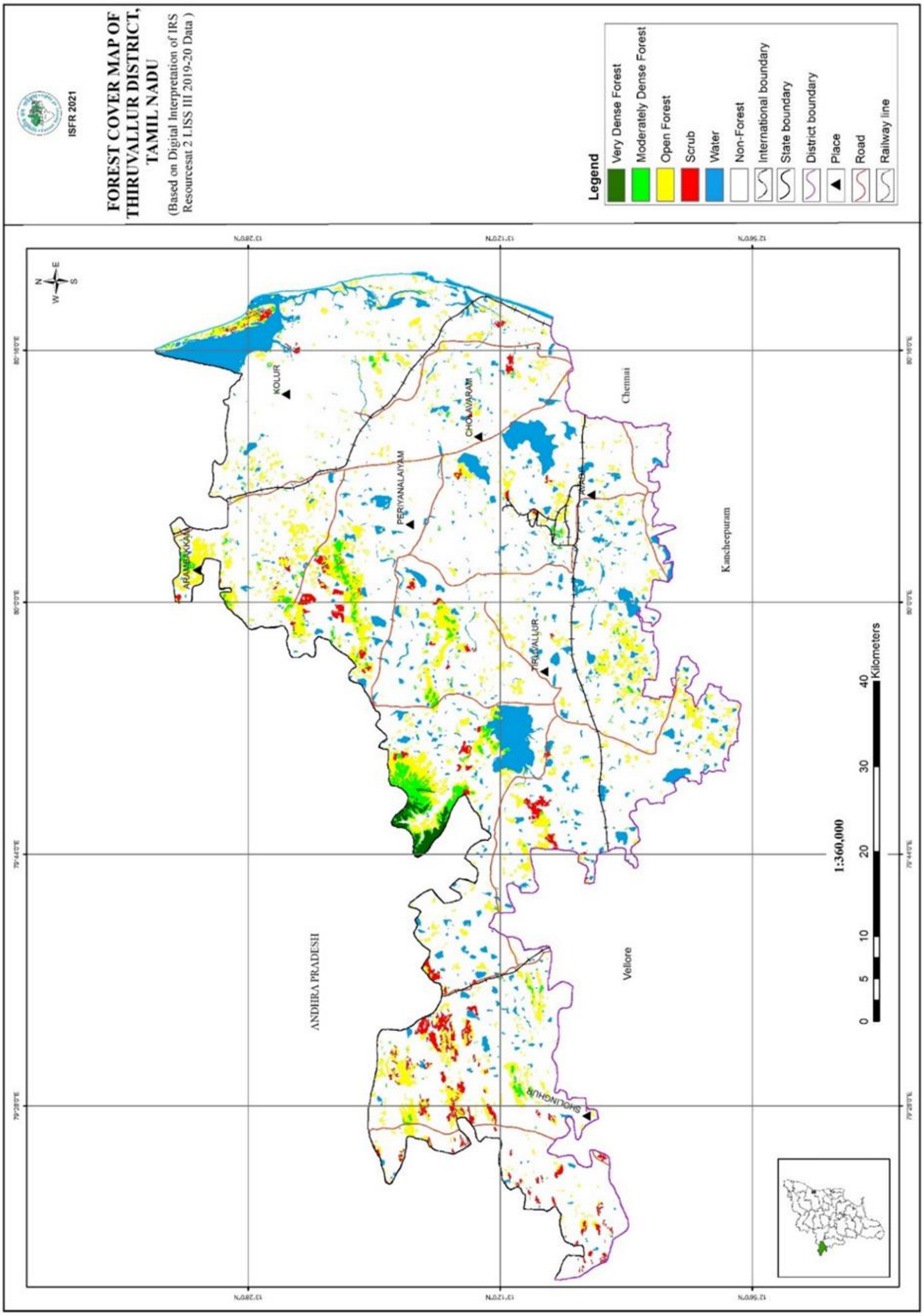
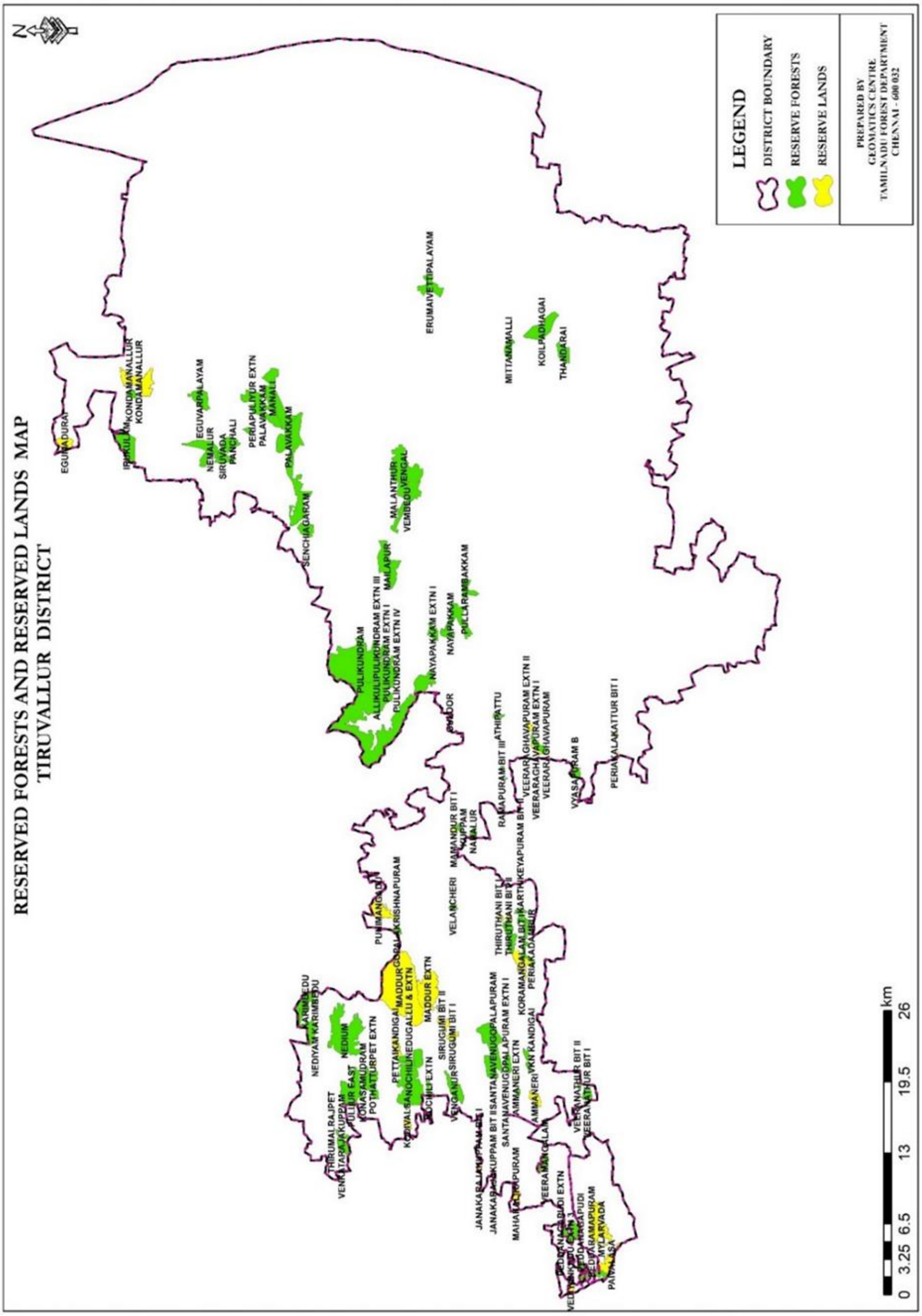


Figure 8.24.4. Map of Notified forests in Thiruvallur district



25. TIRUVARUR

Located in the Cauvery delta region, Tiruvarur's major economic activity has been agriculture. The total geographical area is 2274 sq.km. and the forest cover is only 3.08% of the total area. The recorded forest area of this district is also comparatively less than other districts. The total recorded forest area is 120.7 sq.km. with 11 reserved forests and 2 reserved lands. The total forest cover area is 70.07 sq.km. only, which is lesser than the recorded forest area. This indicates that the tree cover inside the recorded forest area is quite less than the expected and requires intensive efforts to increase the canopy density.

The Very dense forest category did not have any recording until 2017. From 2019, 0.46 sq.km was estimated for the first time. The moderately dense forest category was increasing from 16 sq.km. (2003) to 42 sq.km. (2013), thereafter it started to decrease gradually till 2021 (35.65 sq.km.). The open forest category was decreasing initially until 2011, thereafter it increased to 47 sq.km in 2017 followed by a sharp decrease to 31.07 sq.km in 2019. Being a coastal district, frequent tropical cyclones are common here. The reason for the decline in the forest area during 2017 and 2019 could possibly be due to the cyclones. Similar to that of Nagapattinam, efforts should be taken up to create wind/shelter belts, take up large scale plantation with selected native dwarf tree species.

Table 8.25.1: Tiruvarur Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	2716	2716	2716	2716	2716	2716	2274	2274	2274
VDF	0	0	0	0	0	0	0	0.46	0.46
MDF	10	13	23	23	42	40	38	35.94	35.65
OF	16	17	6	7	9	19	47	31.07	33.96
TFCA	26	30	29	30	51	59	85	67.47	70.07
Percent	0.96	1.1	1.07	1.1	1.88	2.17	3.74	2.97	3.08
Change	4	0	1	0	21	8	-11	-17.53	2.6
Scrub	56	1	0	0	0	0	0	0	0

Figure 8.25.1. Trend analysis of forest in Tiruvarur

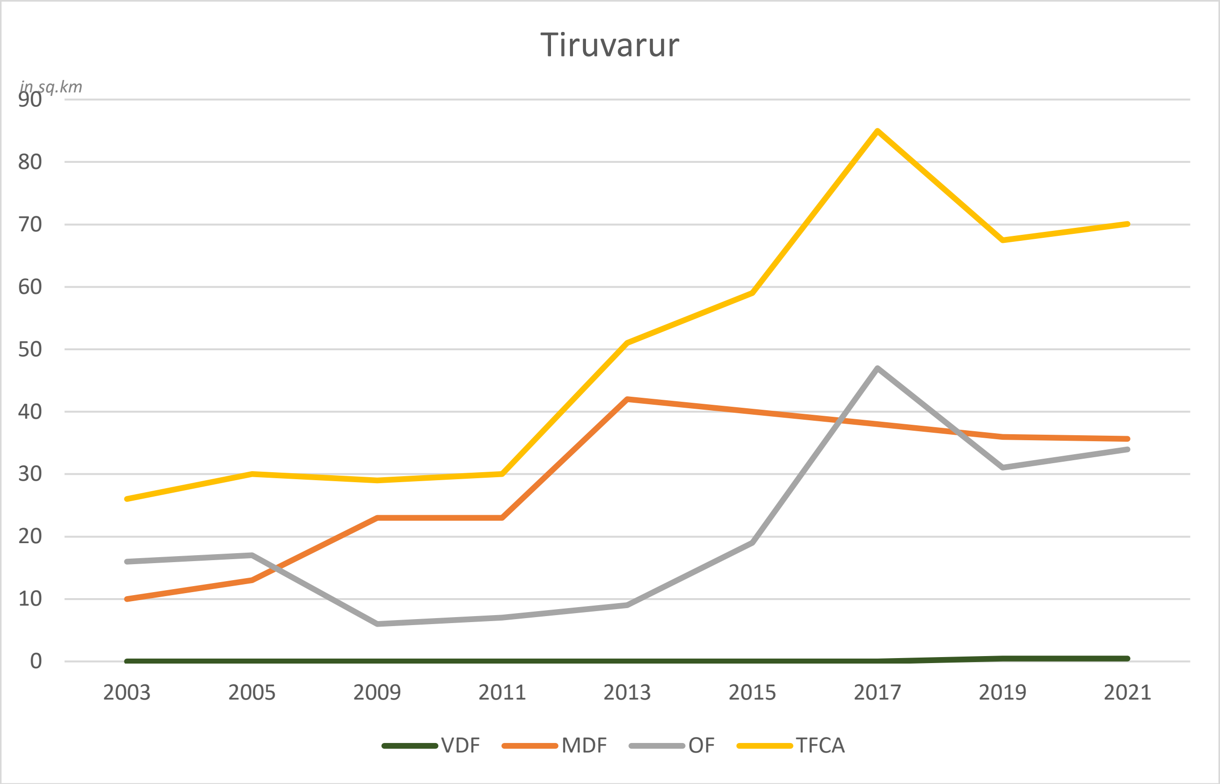


Figure 8.25.2. Share of Forest & non-forest area in Tiruvarur district (2021)

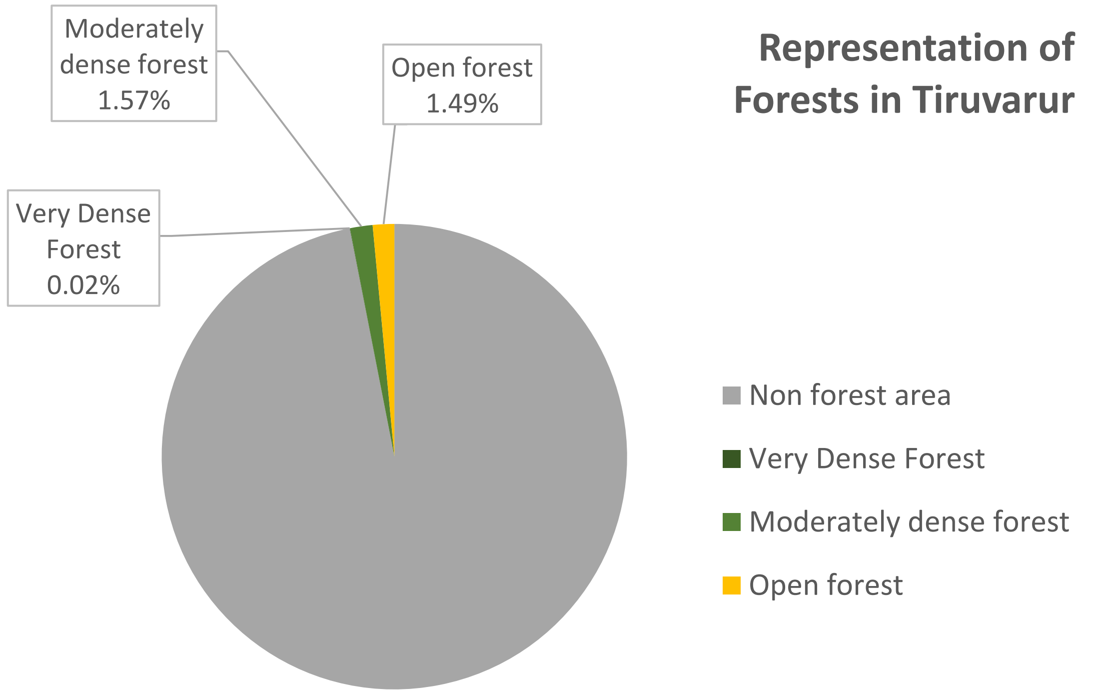


Figure 8.25.3. Forest Cover map of Tiruvarur district

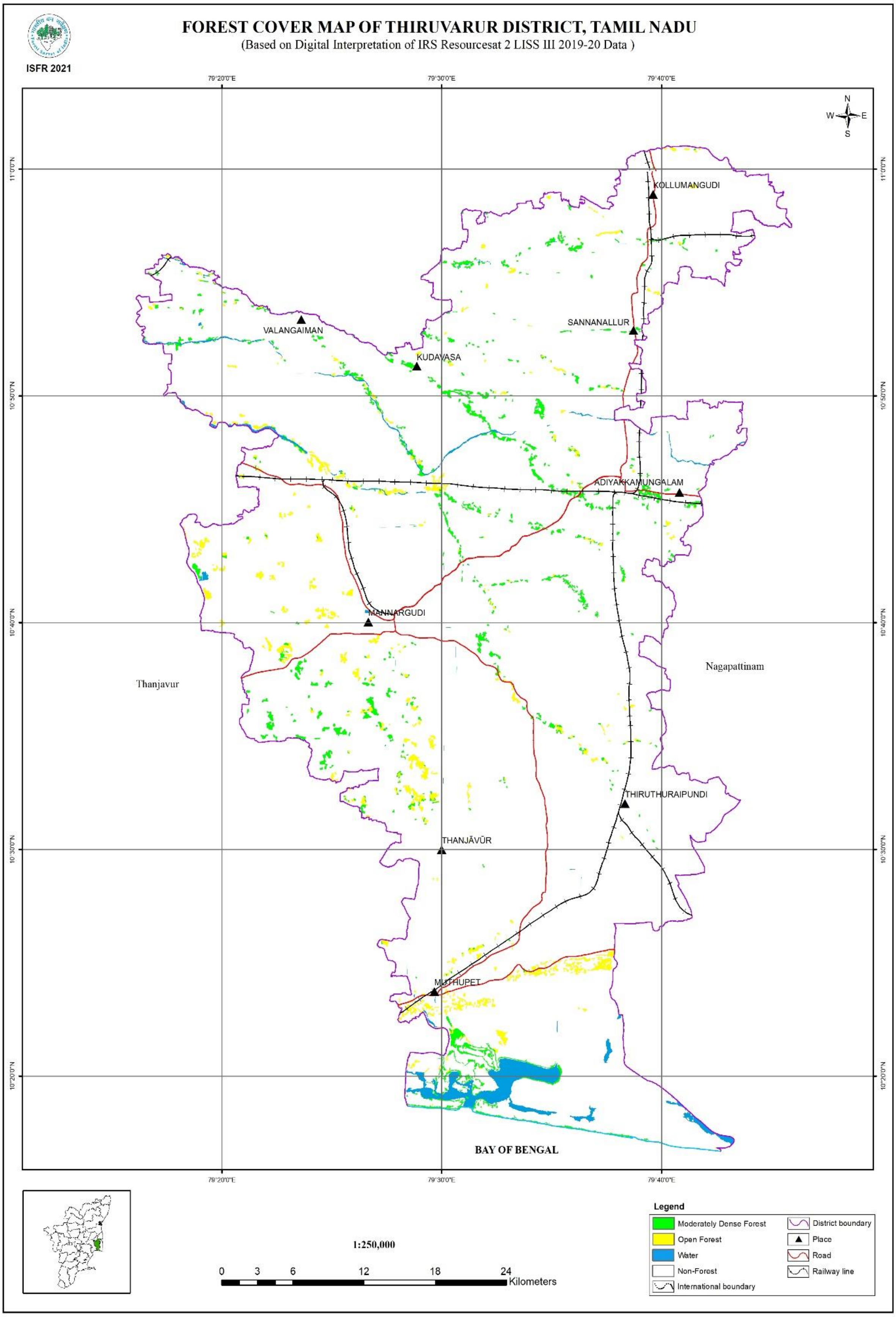
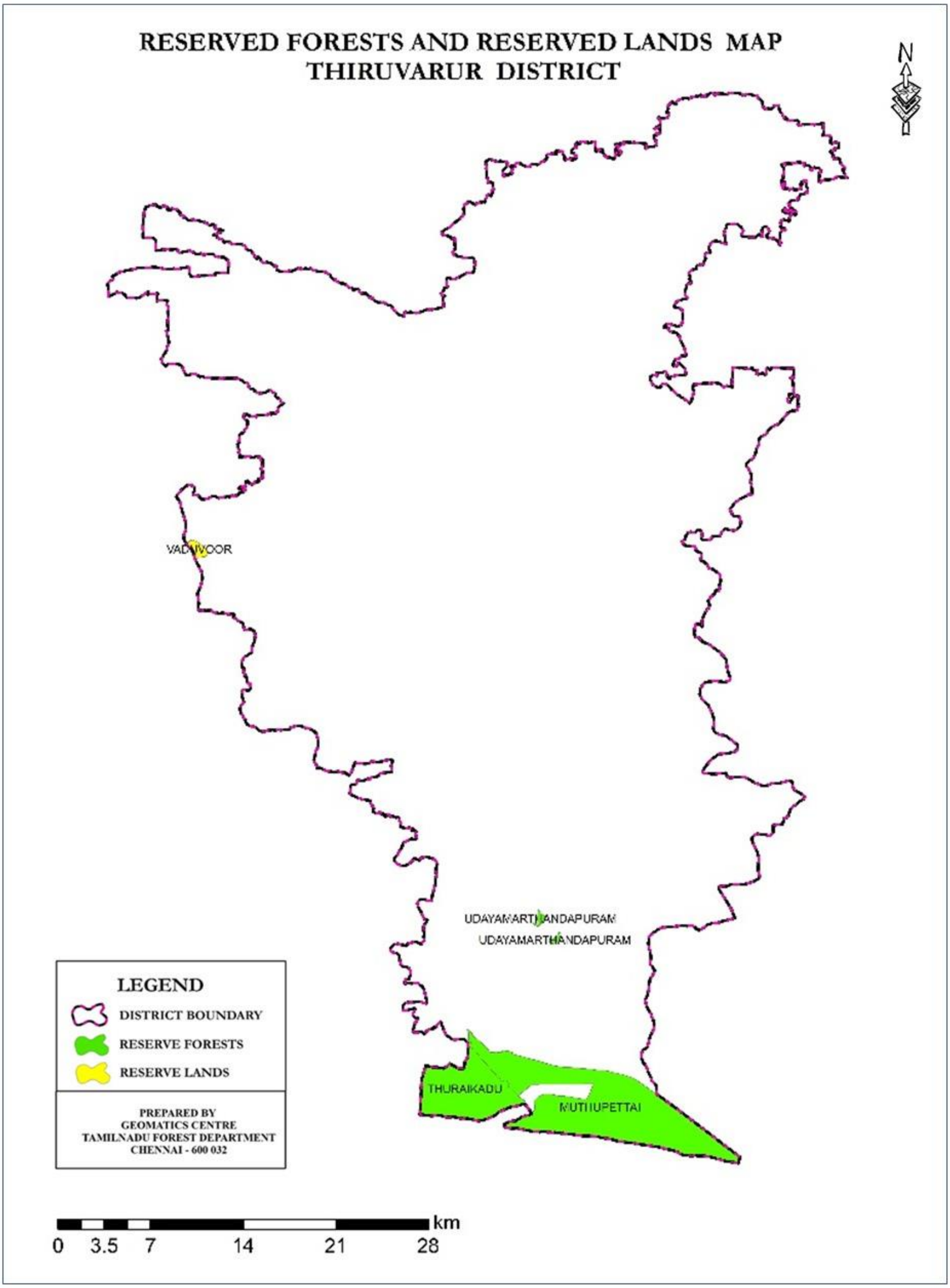


Figure 8.25.4. Map of Notified forests in Tiruvarur district



26. TIRUCHIRAPALLI

Tiruchirapalli is located in the center region of Tamil Nadu with a geographical area of 4509 sq.km. The total forest cover area is about 475.8 sq.km. which constitutes 10.55% of the total area. The total recorded forest area is 464.83 sq.km. which includes 86 reserved forests and 4 reserved lands.

All three density classes of forest are available in Tiruchirapalli. Though the very dense forest category was increasing gradually from 2003 to 2015 from 69 to 79 sq.km., it started to decline sharply from 2017 onwards. The estimated loss of about 15 sq.km. in very dense forest category should be analyzed in depth. The moderately dense forest category was decreasing initially and started to increase from 2015 onwards at a very good rate. There is a net increase of about 75 sq.km. in the moderately dense forest. The open forest has been varying largely with increase and sharp declines all throughout the study period. However, there is net increase of about 22 sq.km. roughly between 2003 and 2021. This variation in the area of the open forest has also affected the total forest cover area. Despite the fluctuations in the estimated total forest cover area, there is a net increase in the area by 80 sq.km. roughly.

Trichy district has a good scope to improve the tree outside forest. There are large tracts of fallow land owing to factors like drought, climate change and less rainfall. So mass plantation drives of native tree species can be carried out after conducting proper soil assessment in these fallow lands.

Table 8.26.1: Tiruchirapalli Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	4511	4511	4511	4511	4511	4511	4509	4509	4509
VDF	69	69	74	74	75	79	55	53.53	53.53
MDF	153	160	146	145	146	153	226	228.35	228.35
OF	172	205	190	188	205	216	202	189.48	193.94
TFCA	394	434	410	407	426	448	483	471.36	475.82
Percent	8.73	9.62	9.09	9.02	9.44	9.93	10.71	10.45	10.55
Change	22	28	-1	-2	19	22	30	-11.64	4.46
Scrub	49	94	50	48	45	25	31	30.33	33.61

Figure 8.26.1. Trend analysis of forest in Tiruchirapalli

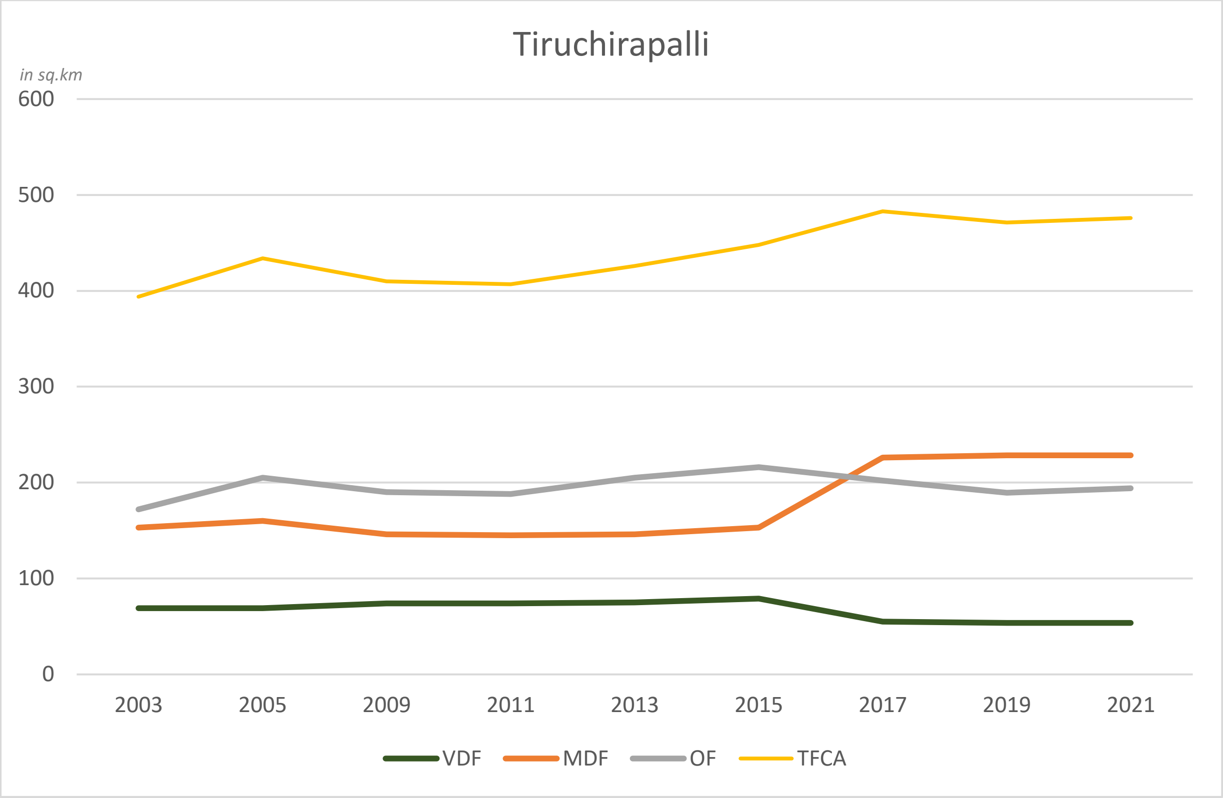


Figure 8.26.2. Share of Forest & non-forest area in Tiruchirapalli district (2021)

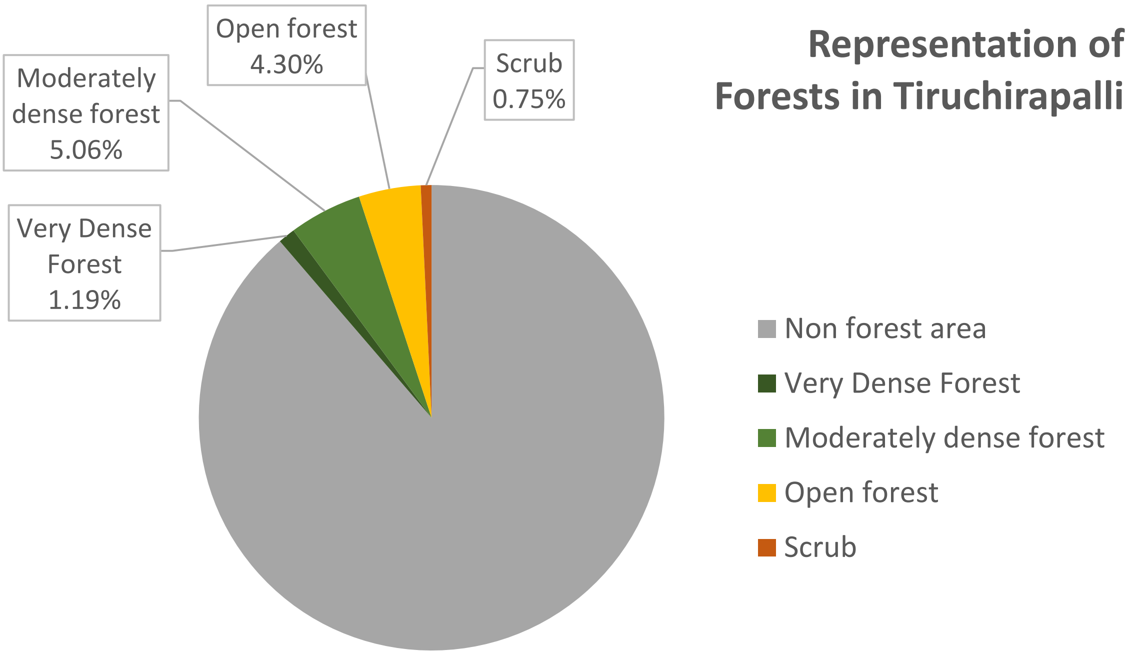


Figure 8.26.3. Forest Cover map of Tiruchirapalli district

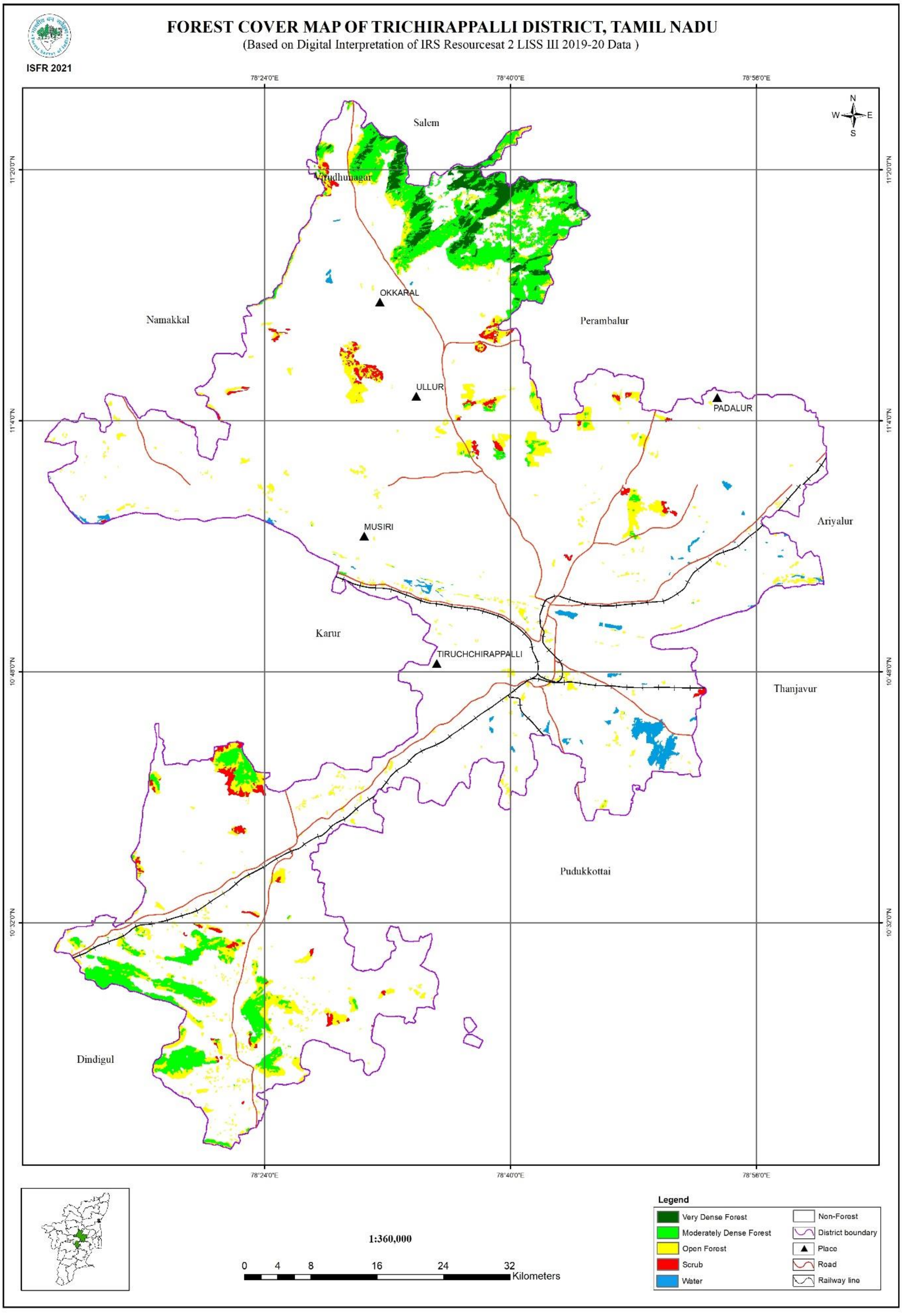
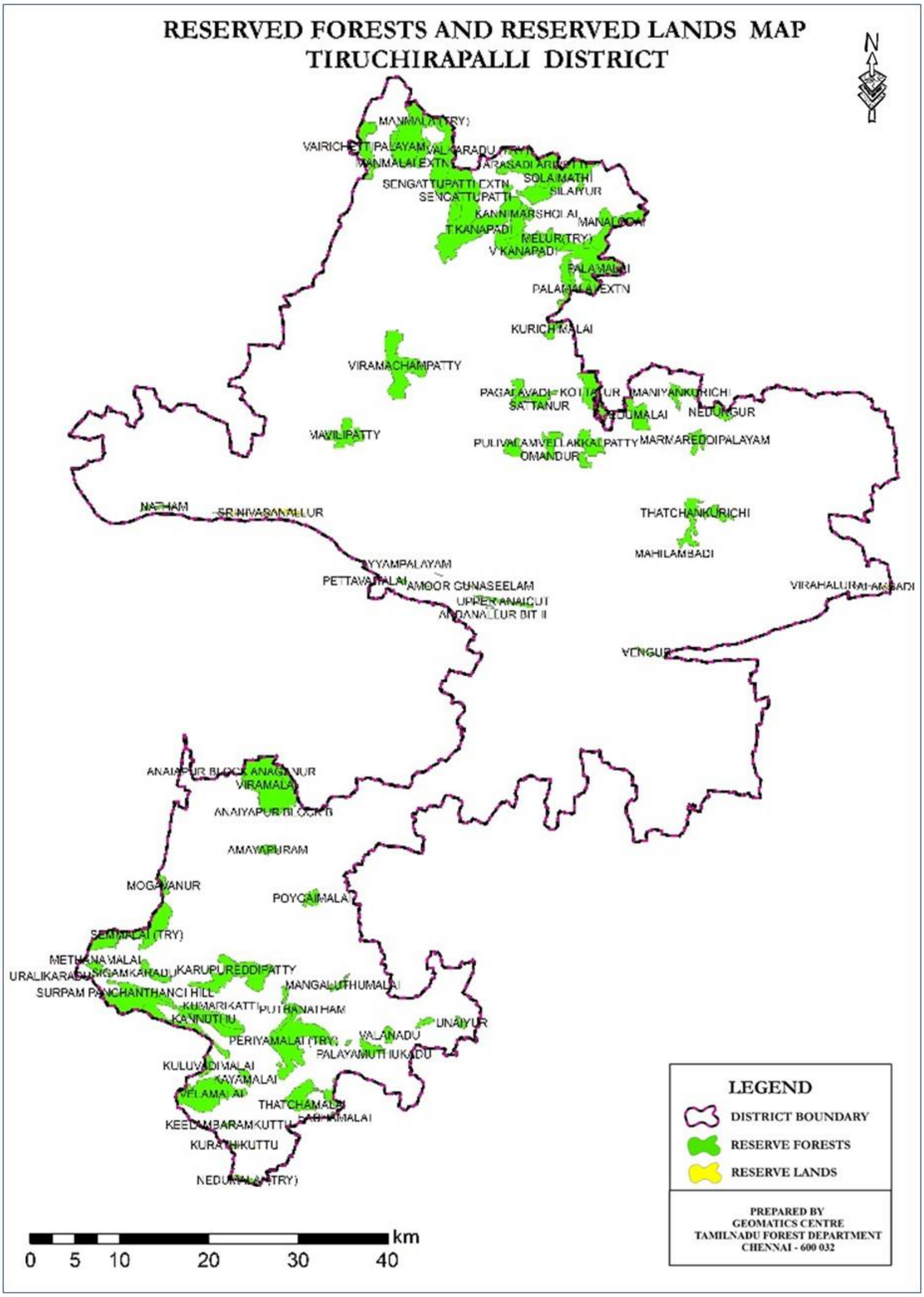


Figure 8.26.4. Map of Notified forests in Tiruchirapalli district



27. TIRUNELVELI

Tirunelveli is bestowed with rich biodiversity as Western Ghats is located towards the western side of the district. Parts of Kalakad Mundanthurai Tiger Reserve and Agasthiyamalai biosphere reserve are located here. The total geographical area is 6693 sq.km. out of which 1302.5 is estimated as the total forest cover area that constitutes 19.46% of the total area. The recorded forest area is 881 sq.km. which includes 20 reserved forests, 6 reserved lands and the rest occupied by the unclassified forest lands. The fact that the total forest cover area is more than the recorded forest area indicates that the district has a good amount of the tree outside forest that contributes to the green cover of the district.

Tirunelveli is one such district which has a good percentage of the dense forest. The very dense forest is estimated to occupy 6.61% of the total geographical area. The very dense forest has been constantly increasing from 2003 until 2021. The net increase in the area of the very dense forest is roughly 240 sq.km. The main reason for this is the intensive protection given to the existing forests due to the legal status of the tiger reserve and biosphere reserve. The moderately dense forest was also increasing initially until 2015, there after it stared to decline sharply. The decline in the area of the moderately dense forest overlaps with the sharp increase in the area of the dense forest category between 2017 to 2021. So, it can be inferred that the protection and the conservation measures has contributed to the improvement in the canopy density leading to the change in the density class. The open forest has recorded a sharp decline in the initial years and then it started to increase from 2015. The decline in the initial years has been the reason for the net loss in the open forest area by 54 sq.km. Despite this loss in the open forest area, the total forest cover area continued to increase from 1099 sq.km in 2003 to 1302.5sq.kms in 2021.

Table 8.27.1: Tirunelveli Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	6810	6810	6810	6810	6810	6810	6693	6693	6693
VDF	203	227	282	278	279	289	441	442.45	442.48
MDF	549	622	780	760	761	727	564	567.02	566.56
OF	347	293	177	179	192	292	295	290.77	293.46
TFCA	1099	1142	1239	1217	1232	1308	1300	1300.24	1302.5
Percent	16.14	16.77	18.19	17.87	18.09	19.21	19.42	19.43	19.46
Change	50	0	4	-3	15	76	4	0.24	2.26
Scrub	158	86	47	44	45	15	23	24.31	26.08

Figure 8.27.1. Trend analysis of forest in Tirunelveli

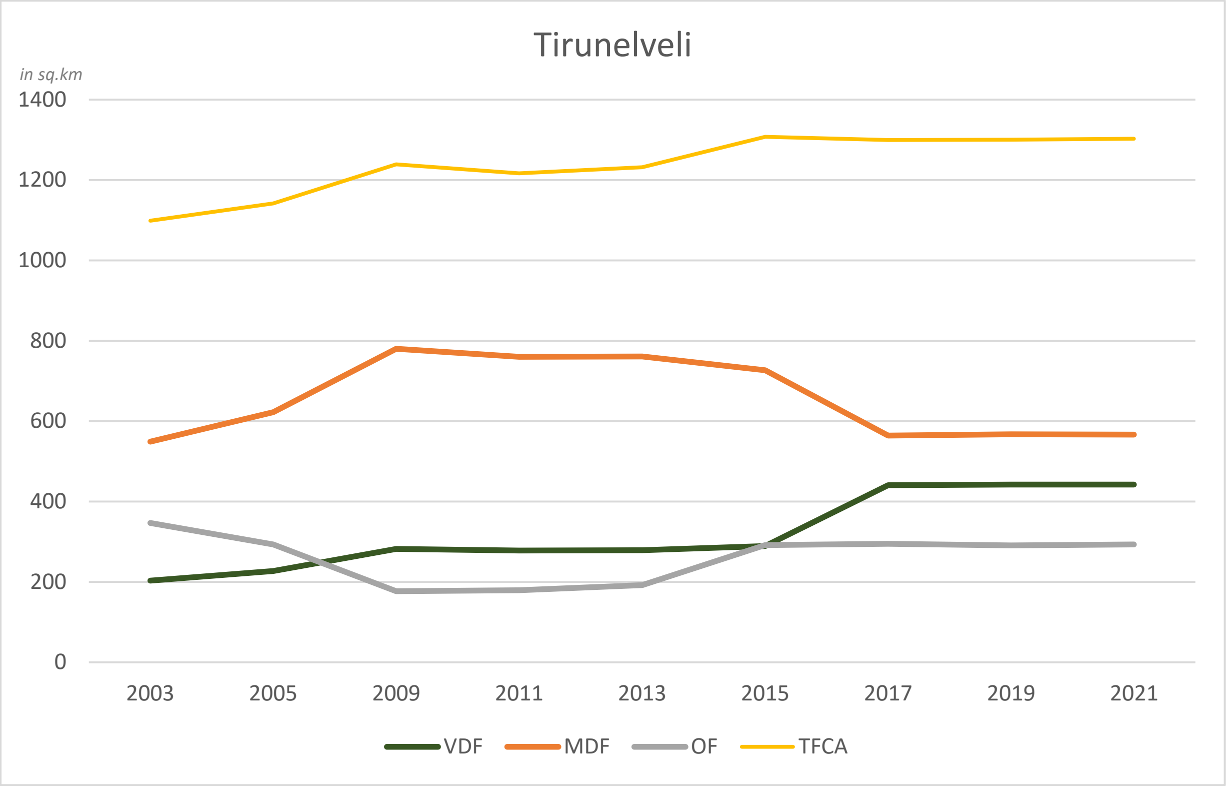


Figure 8.27.2. Share of Forest & forest area in Tirunelveli district (2021)

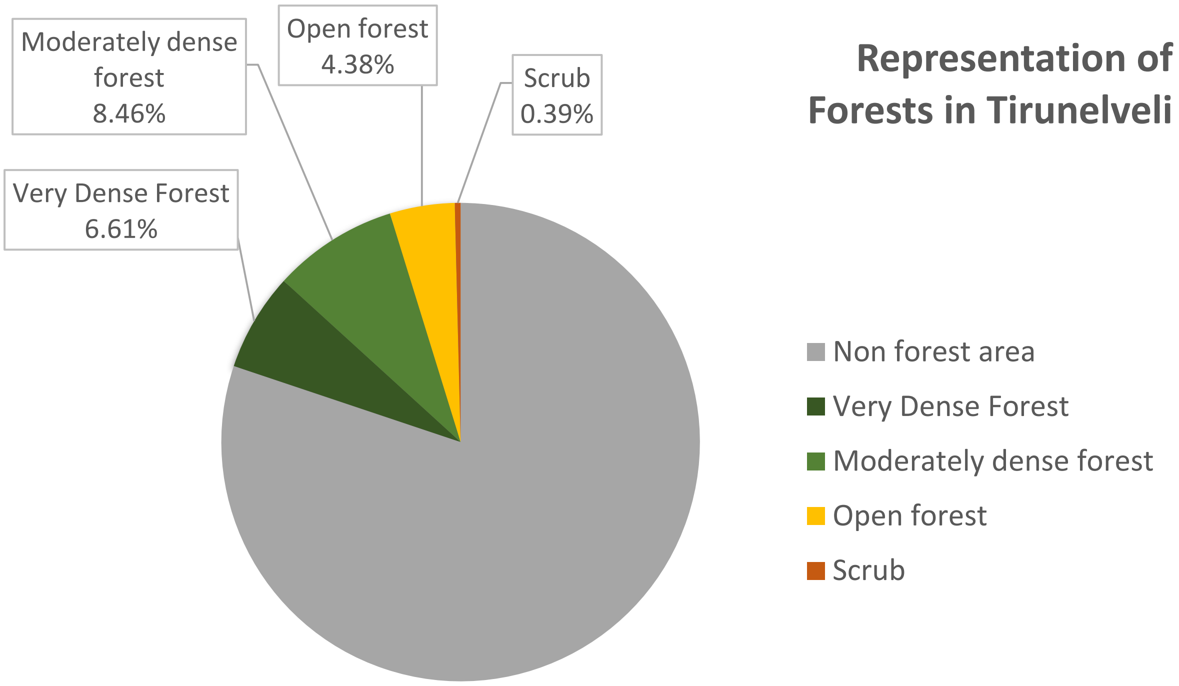


Figure 8.27.3. Forest Cover map of Tirunelveli district

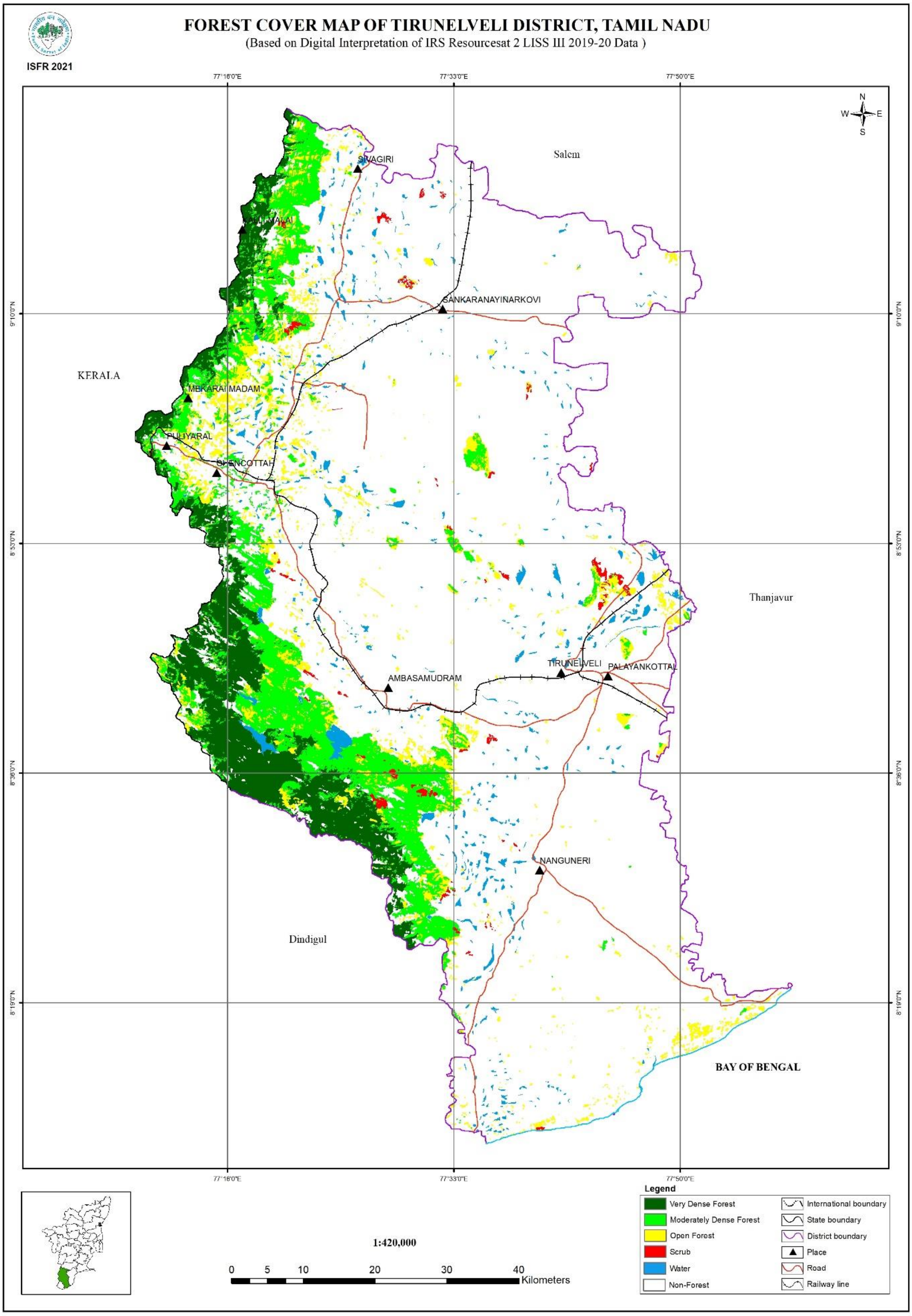
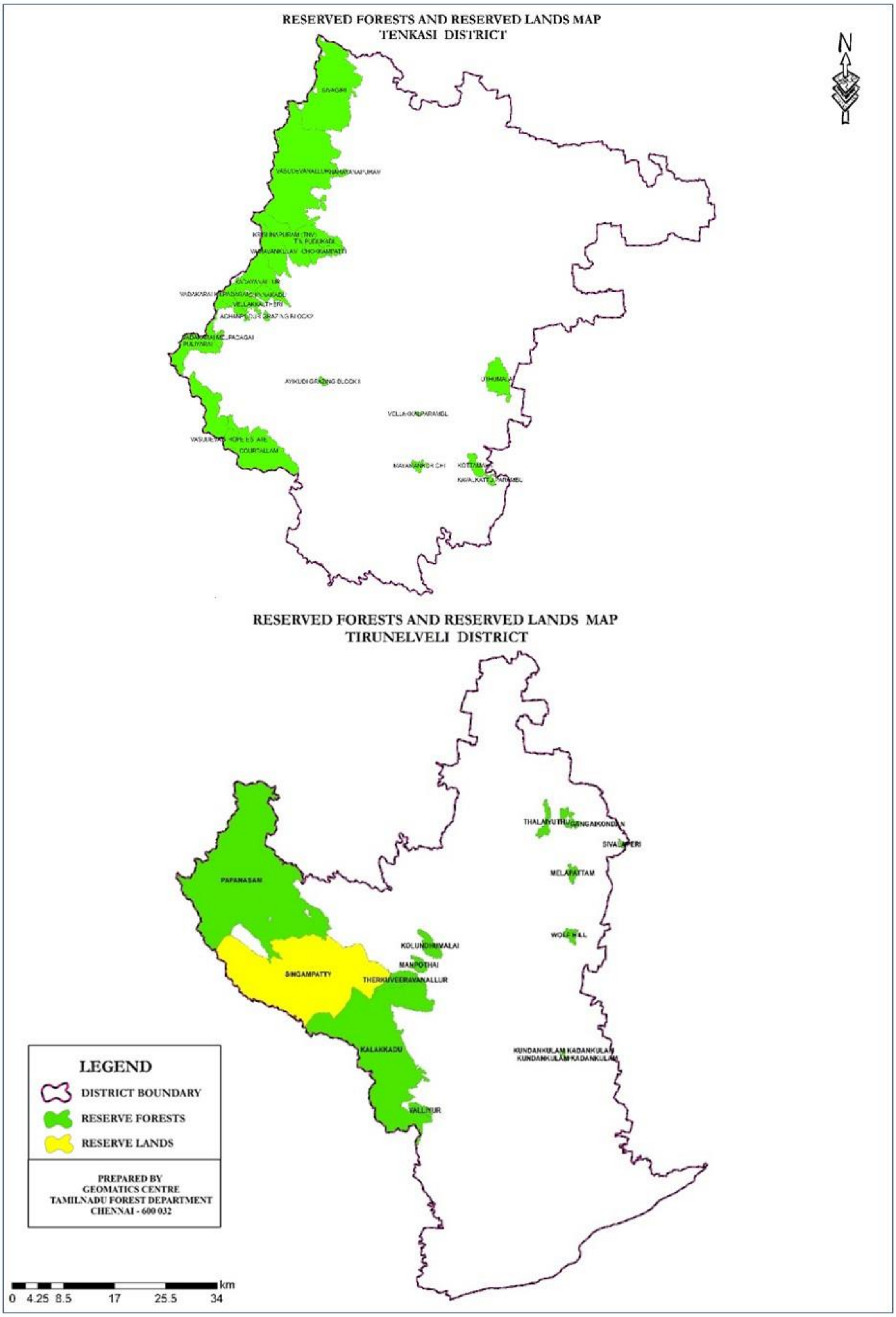


Figure 8.27.4. Map of Notified forests in Tirunelveli district



28. TIRUVANNAMALAI

Tiruvannamalai is one of the largest districts in Tamil Nadu with an area of 6188 sq.km. The total forest cover area in this district is estimated to be 1312.35 sq.km that constitutes 21.21% of the total area. The recorded forest area is 1455.7 sq.km which includes 75 reserved forests and 16 reserved lands. One observation is the recorded forest area is more than the total forest cover area which indicates there is a high scope to increase the tree cover within the recorded forest area.

The Very dense forest category continued to increase from 2003 with a net increase in area of 68 sq.km. The moderately dense forest increased until 2011 followed by a sharp decline in 2015 and then it started to increase sharply in 2017. There is a net gain by 118 sq.km. Though the open forest increased initially, there is a decline since 2009 and a sharp fall in 2017. There is a net loss of open forest of about 190 sq.km. With all these variations in the three-density classes, the total forest cover area has largely been in the same range. But there is a net loss of total forest cover area by 3 sq.km. Despite all the available possibilities to increase the green cover in Tiruvannamalai, the total forest cover area has not been increasing for the past two decades. The scope of agro-forestry and tree outside forest must be worked out with a specially customized strategy for this district.

Table 8.28.1: Tiruvannamalai Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	6191	6191	6191	6191	6191	6191	5188	6188	6188
VDF	165	165	169	169	172	174	234	233.79	233.64
MDF	478	483	523	523	512	493	595	595.83	596.61
OF	672	742	695	695	685	632	483	478.74	482.1
TFCA	1315	1390	1387	1387	1369	1299	1312	1308.36	1312.35
Percent	21.24	22.45	22.4	22.4	22.11	20.98	21.2	21.14	21.21
Change	123	3	0	0	-18	-70	20	-3.64	3.99
Scrub	28.5	57	57	57	59	44	23	67.06	71.22

Figure 8.28.1. Trend analysis of forest in Tiruvannamalai

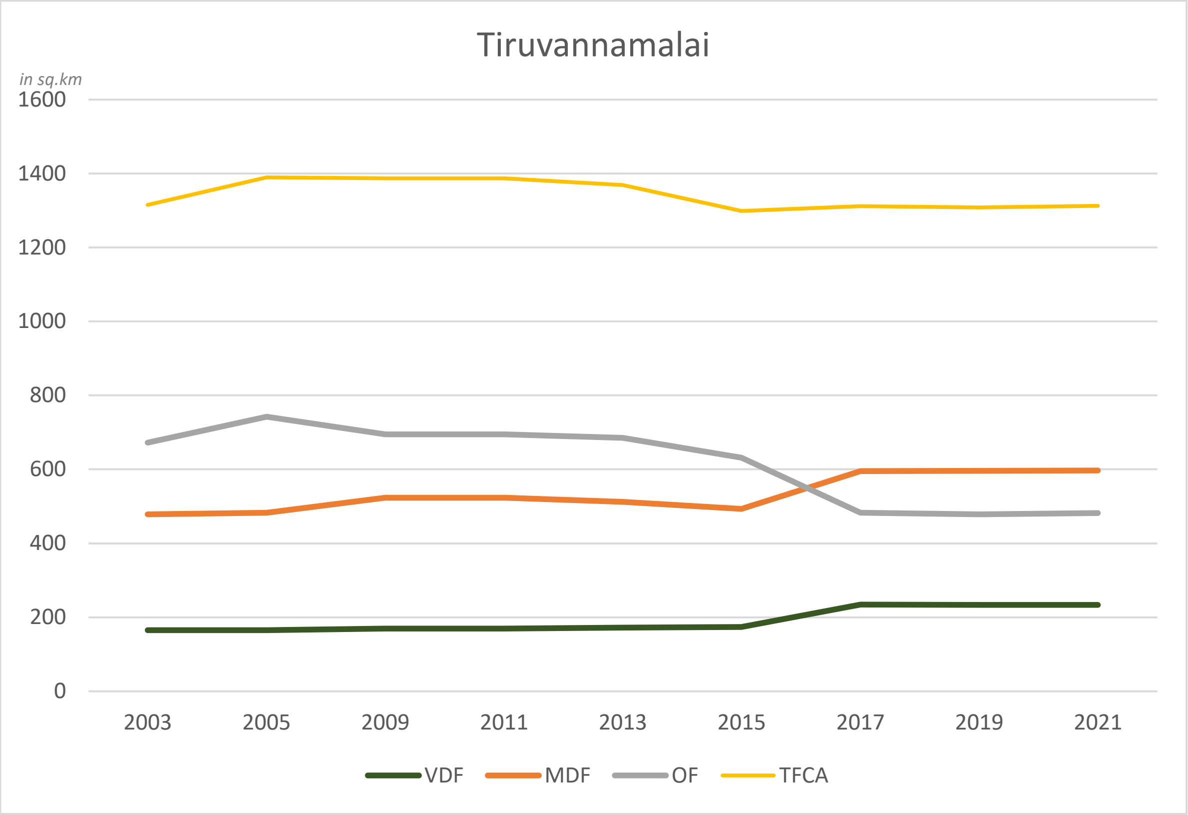


Figure 8.28.2. Share of Forest & non-forest area in Tiruvannamalai district (2021)

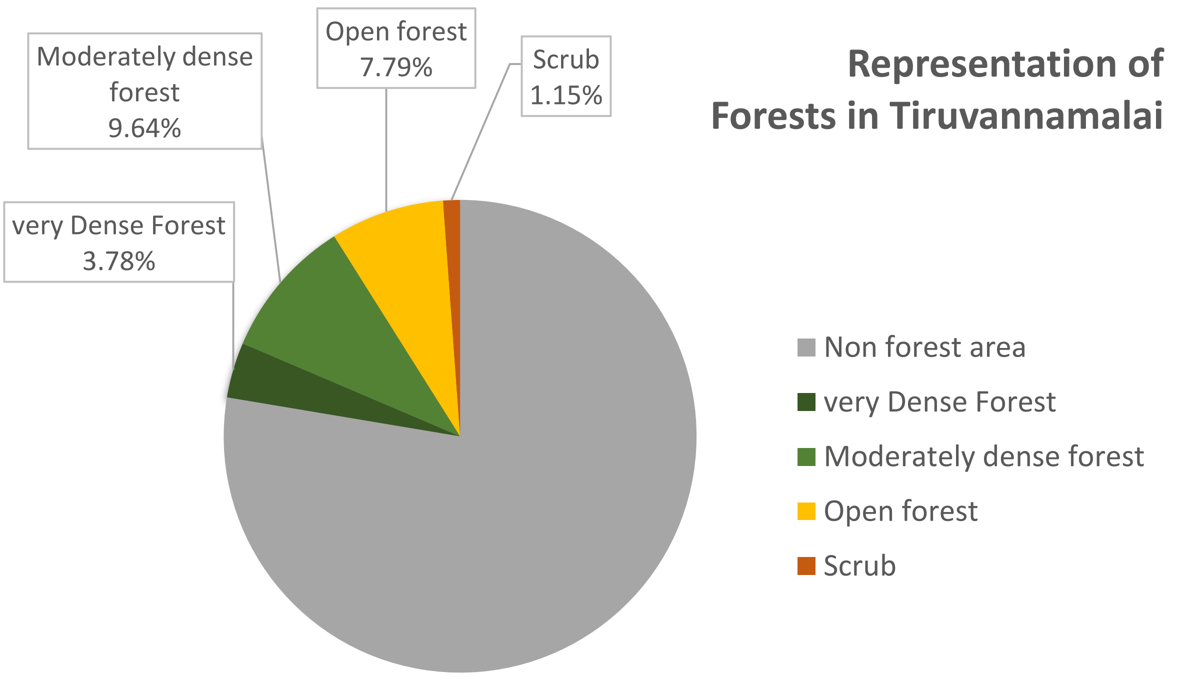


Figure 8.28.3. Forest Cover map of Tiruvannamalai district

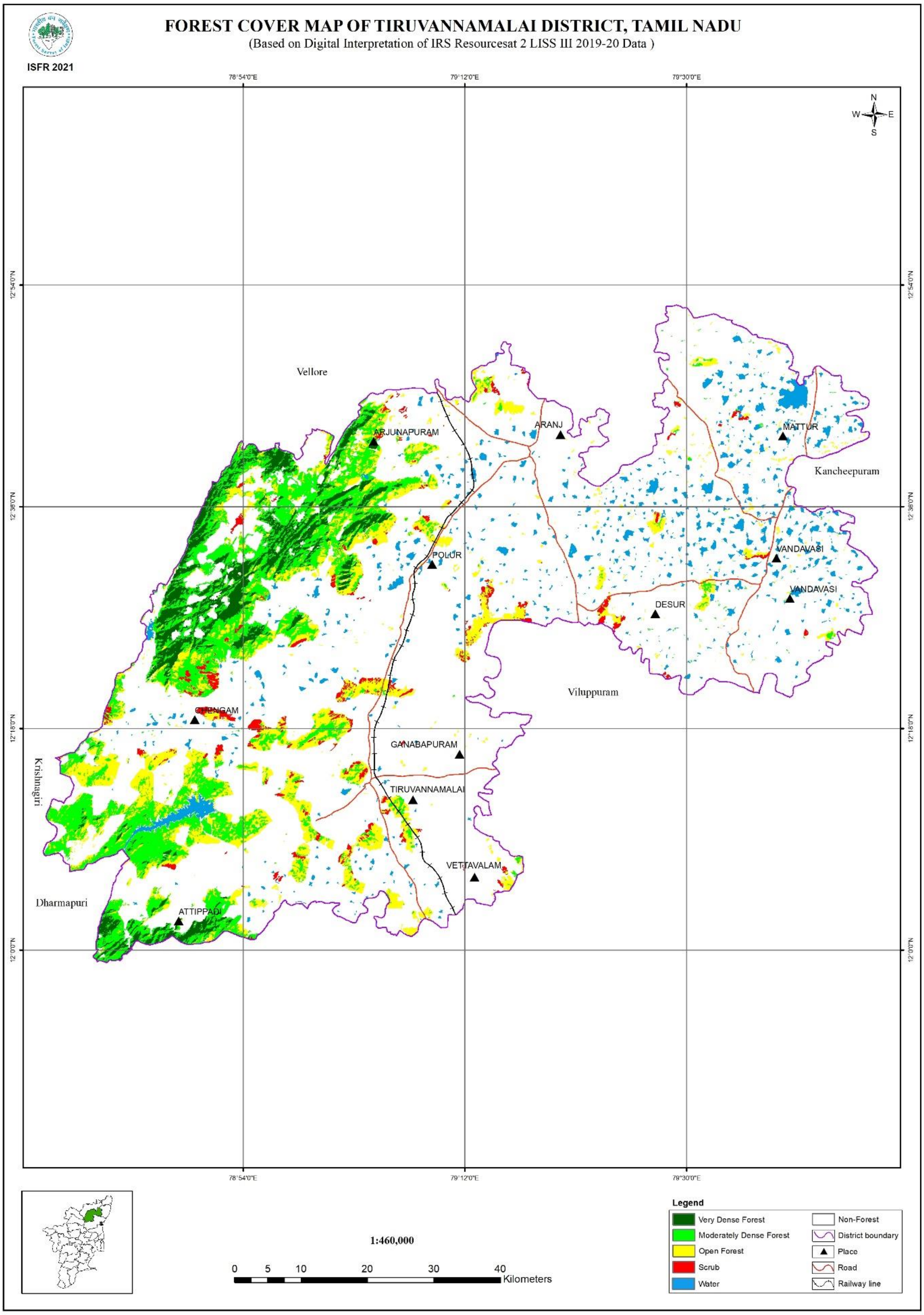
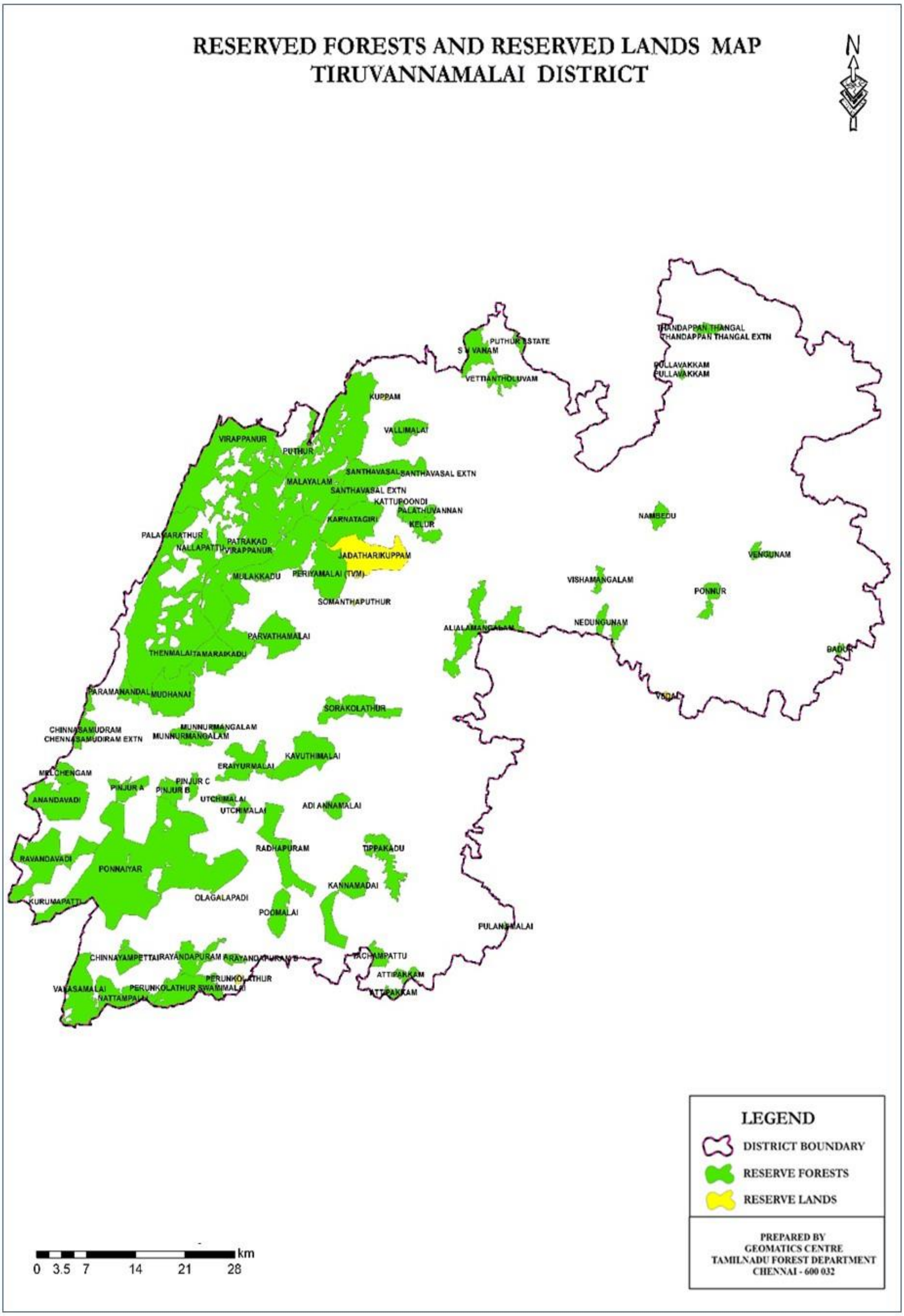


Figure 8.28.4. Map of Notified forests in Tiruvannamalai district



29. THOOTHUKUDI

Thoothukudi is one among the 14 coastal districts that is located towards the south of Tamil Nadu. The total geographical area is 4745 sq.km. With only 108 sq.km of the recorded forest area that has 8 reserved forests and 10 reserved lands and 251 sq.km. of total forest cover area, Thoothukudi has only 5.31% of forest cover. But an interesting observation is that the TOF contributes more to the total forest cover area in this district.

Out of the 5.31% of total forest cover area – moderately dense forest contributes only 0.54% and open forest with 4.77%. The open forest category has been increasing steadily from 2003 to 2017, further it has decreased marginally after 2017. The total forest cover area also follows a similar trend of increase till 2017 and decreases there after until 2021. The reason for this decline in the open forest category must analysed and measures should be taken to control this. About 1.47% of total geographical area is scrub land with an area of 69.75 sq.km. Special drives like mass tree planting clubbed with water conservation measures shall be taken up in the scrub lands to improve its tree cover.

Table 8.29.1: Thoothukudi Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	4621	4621	4621	4621	4621	4621	4745	4745	4745
VDF	0	0	0	0	0	0	0	0	0
MDF	46	50	28	25	25	15	29	26.08	25.72
OF	106	119	139	134	135	224	243	230.6	226.25
TFCA	152	169	167	159	160	239	272	256.68	251.97
Percent	3.29	3.66	3.61	3.44	3.46	5.17	5.73	5.41	5.31
Change	7	-2	1	-5	1	79	24	-15.32	-4.71
Scrub	78.5	22	23	22	22	13	38	68.65	69.75

Figure 8.29.1. Trend analysis of forest in Thoothukudi district

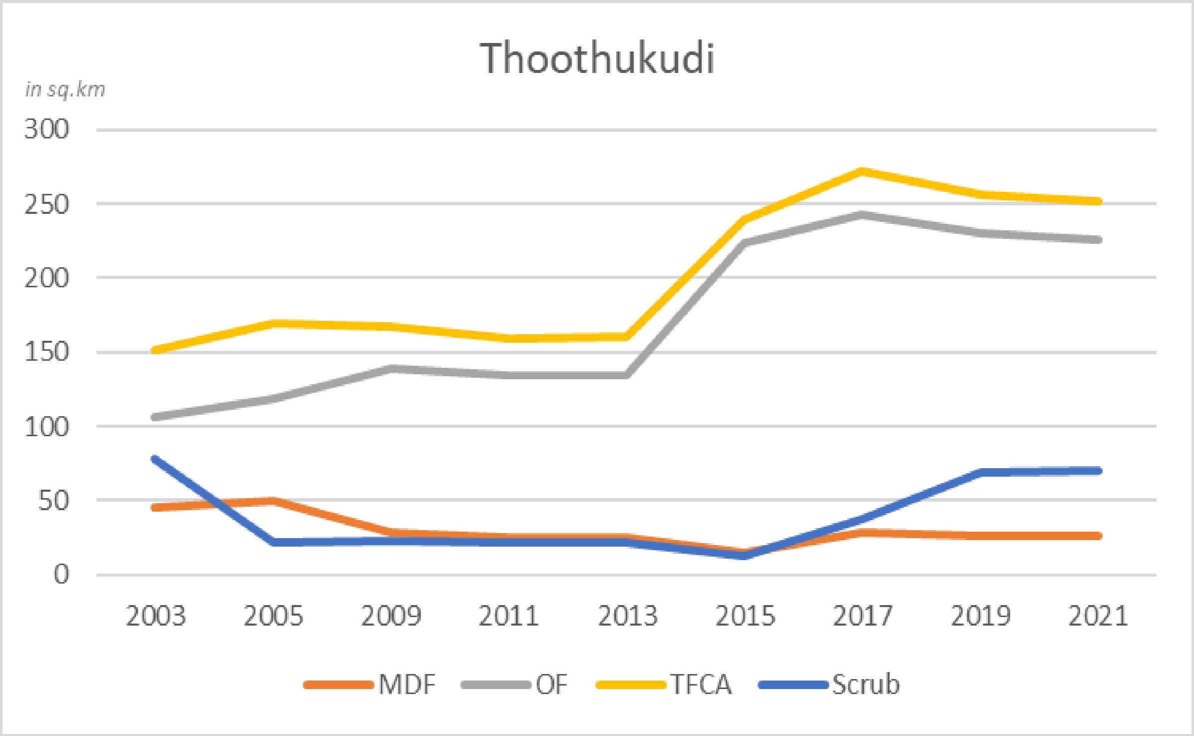


Figure 8.29.2. Share of Forest & non-forest area in Thoothukudi district (2021)

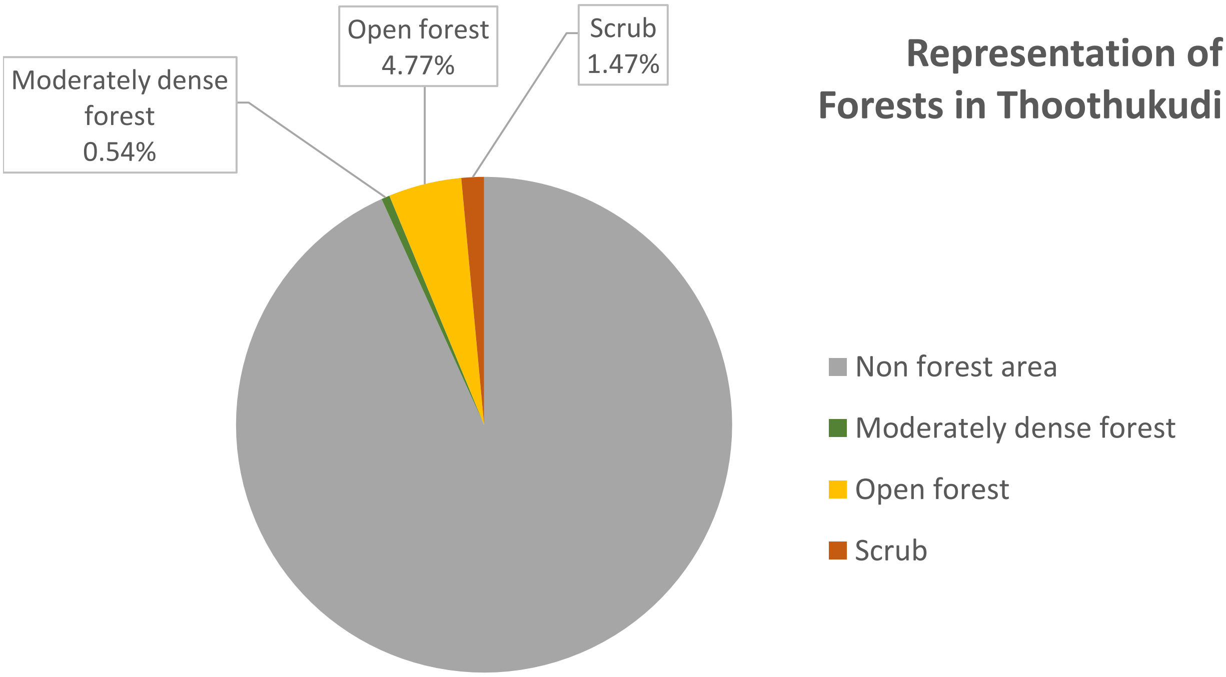


Figure 8.29.3. Forest Cover map of Thoothukudi district

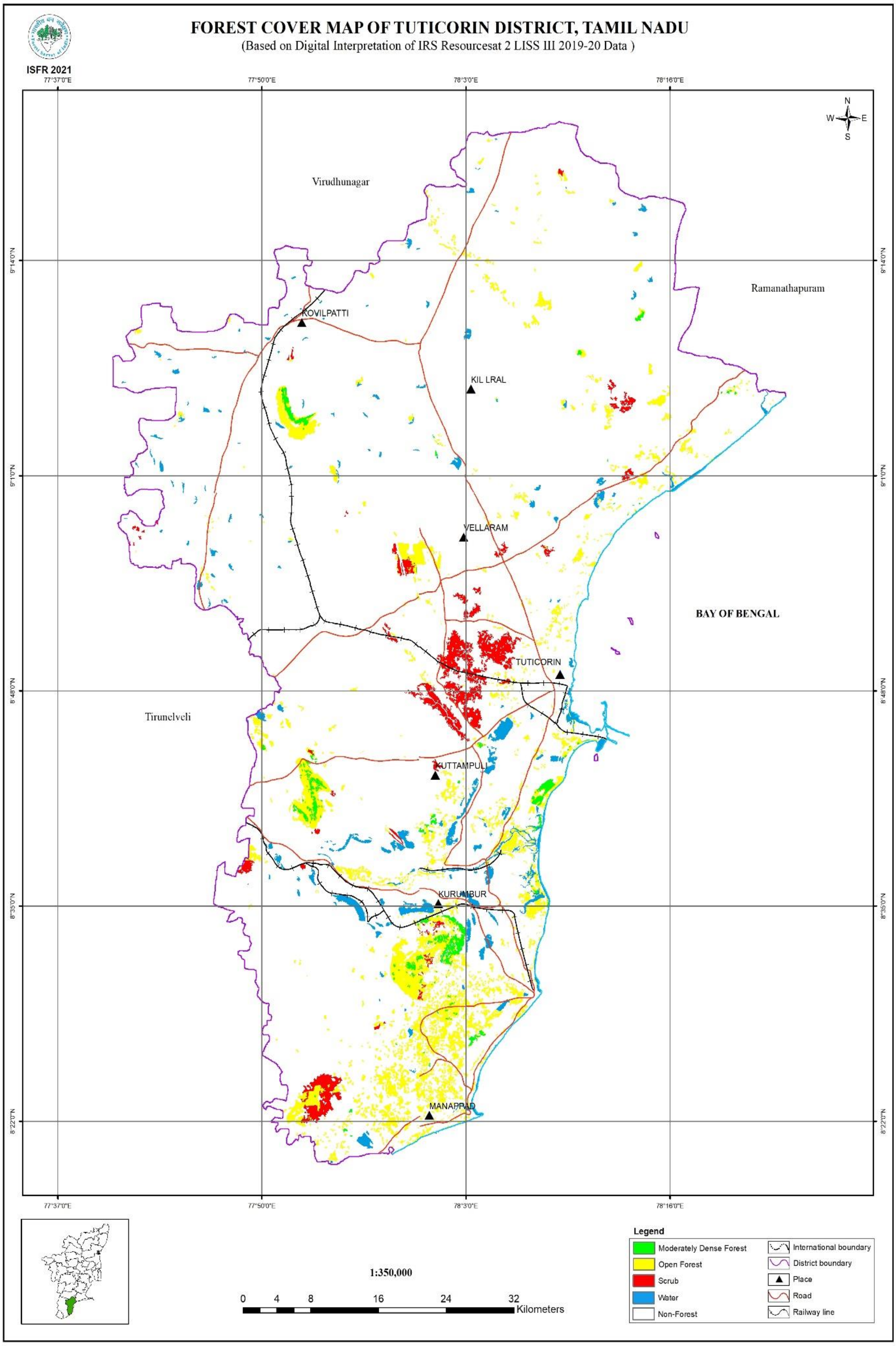
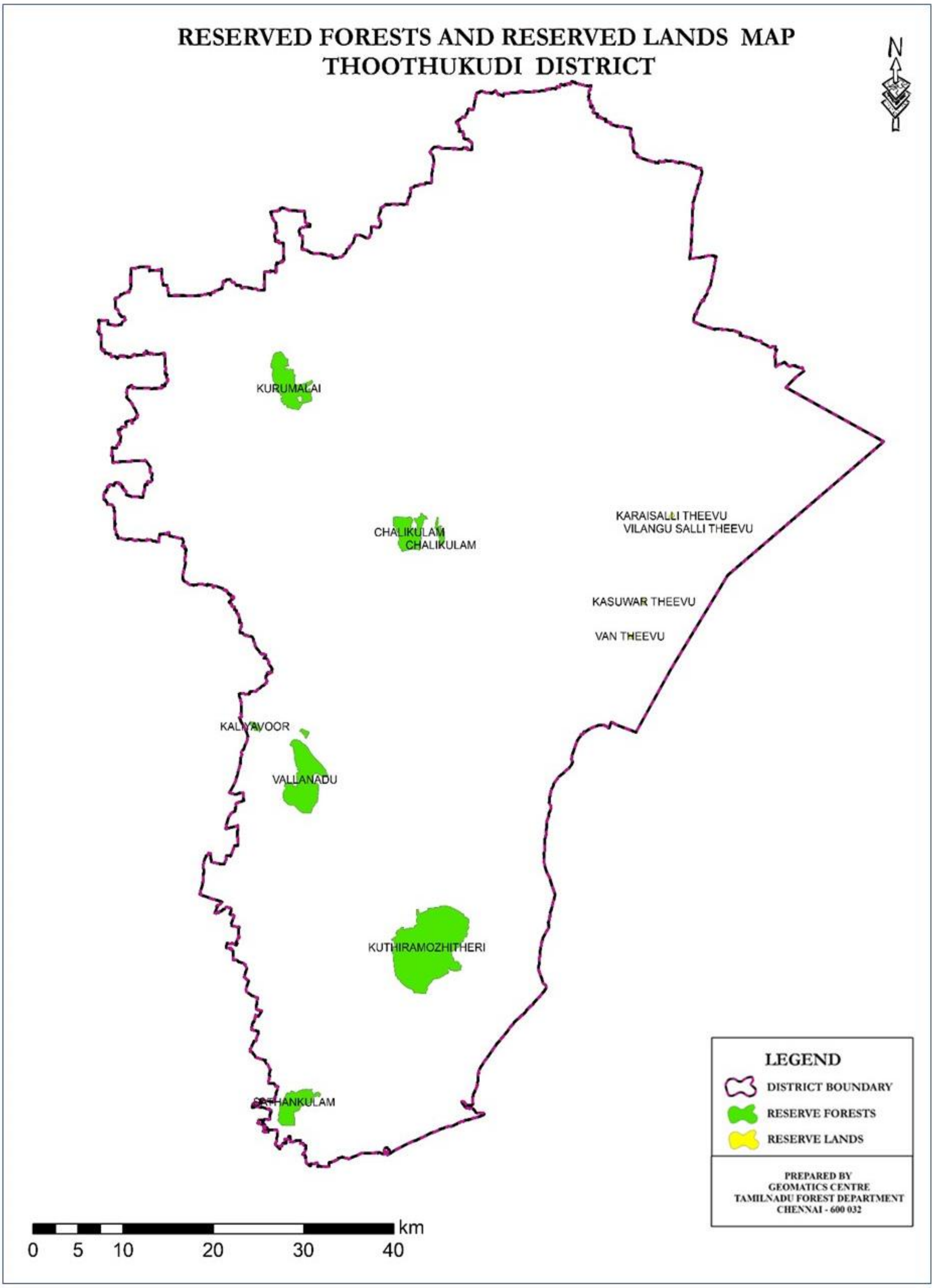


Figure 8.29.4. Map of Notified forests in Thoothukudi district



30. VELLORE

Vellore is one of the major districts located in the North Western part of Tamil Nadu. The western region of the district is covered with good forests as parts of Eastern Ghats range is located here. The district also shares boundary with the neighbouring state of Andhra Pradesh which also has a good portion of forest. Though Vellore is largely perceived as dry district it has about 30.04% of forest cover i.e 1824 sq.km. out of the total geographical area of 6075 sq.km is estimated as total forest cover area. Recently Vellore district was divided to create Tirupattur and Ranipet Districts. But the ISFR 2021 considers only the erstwhile combined area of Vellore district for the forest cover assessment. The total recorded forest area is 1790 sq.km. which includes 113 reserved forests, 16 reserved lands (5 sq.km) and the rest occupied by the unclassified forest lands. Efforts must be taken to notify the unclassified lands as forest in order to ensure the long-term protection of the forest lands. The fact that the recorded forest area is less than the total forest cover area indicates that the Tree Outside Forest (TOF) contributes to the forest cover of the district which is a good indicator. Efforts must be taken up to increase the scope of the TOF in the district.

All three density classes are available in this district. The dense forest category has marginally increased from 165 sq.km. in 2003 to 200.98 sq.km in 2021. Similarly, the moderately dense forest category also has recorded substantial increase in the area from 608 sq.km. in 2003 to 939.55 sq.km. which indicates that about 330 sq.km. have got added in this category during the past 18 years. The reason for this is revealed when we observe the open forest estimate during this period. The values got decreased from 920 sq.km to 684.45 sq.km in 2021. This clearly indicates that a good portion of the open forest area has moved to the moderately dense forest class as the canopy density got improved. This is a positive indicator for conservation and environmental sustainability. The total forest cover area of Vellore has been largely increasing during this period from 1693 sq.km. to 1824.98 sq.km. (2021), though there is a marginal decrease in 2015. One other interesting observation in the scrub land category is a good portion of the area is estimated in this category which indicates that taking up measures to increase the tree cover in these lands will possibly add more to total forest cover area of the district. As Vellore is one of the fast-urbanizing districts, special attention should be given to develop the urban forestry as well.

Table 8.30.1: Vellore Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	6077	6077	6077	6077	6077	6077	6075	6075	6075
DF	165	165	172	172	176	187	203	202.86	200.98
MF	608	614	628	628	615	680	935	937.68	939.55
OF	920	940	938	939	953	990	675	678.05	684.45
TFCA	1693	1719	1738	1739	1744	1857	1813	1818.59	1824.98
Percent	27.86	28.29	28.6	28.62	28.7	30.56	29.84	29.94	30.04
Change	235	0	-3	1	5	113	-28	5.59	6.39
Scrub	136	173	185	184	176	89	76	72.8	76.47

Figure 8.30.1. Trend analysis of Forest in Vellore district

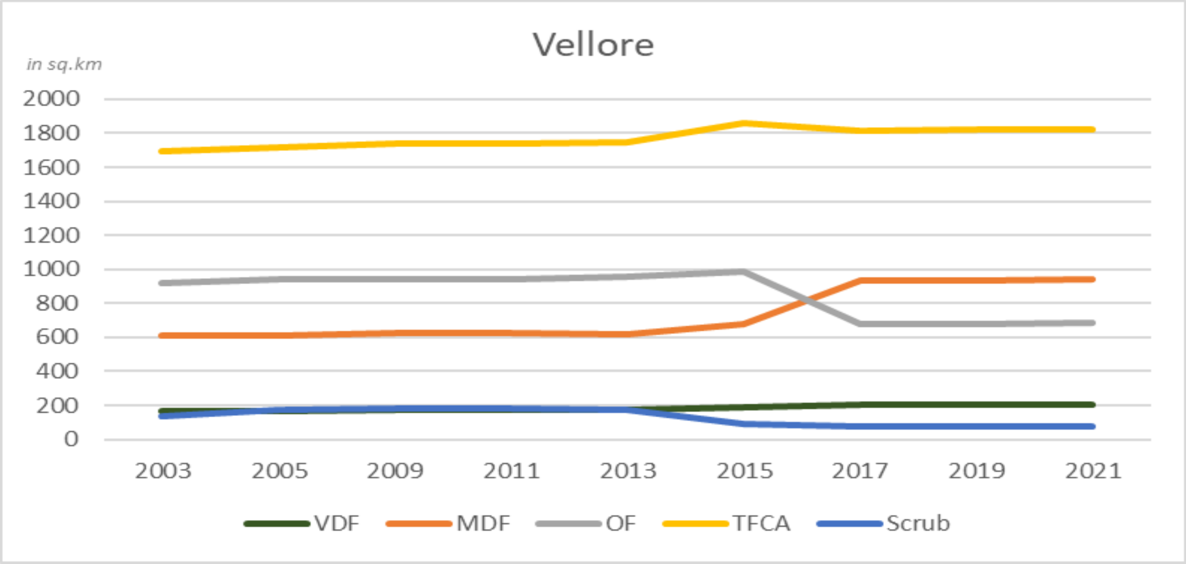


Figure 8.30.2. Share of Forest & non-forest area in Vellore district (2021)

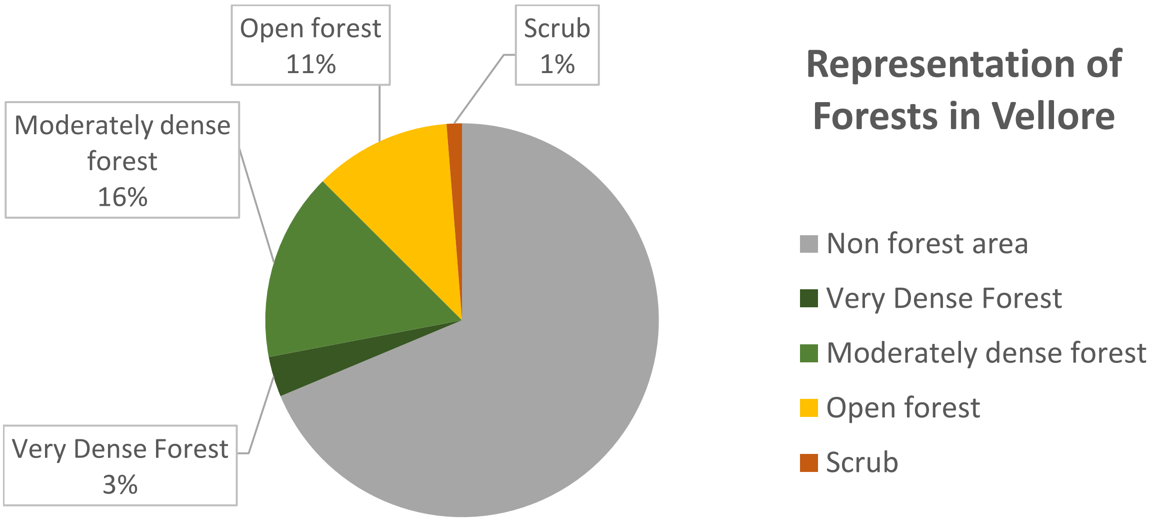


Figure 8.30.3. Forest Cover map of Vellore district

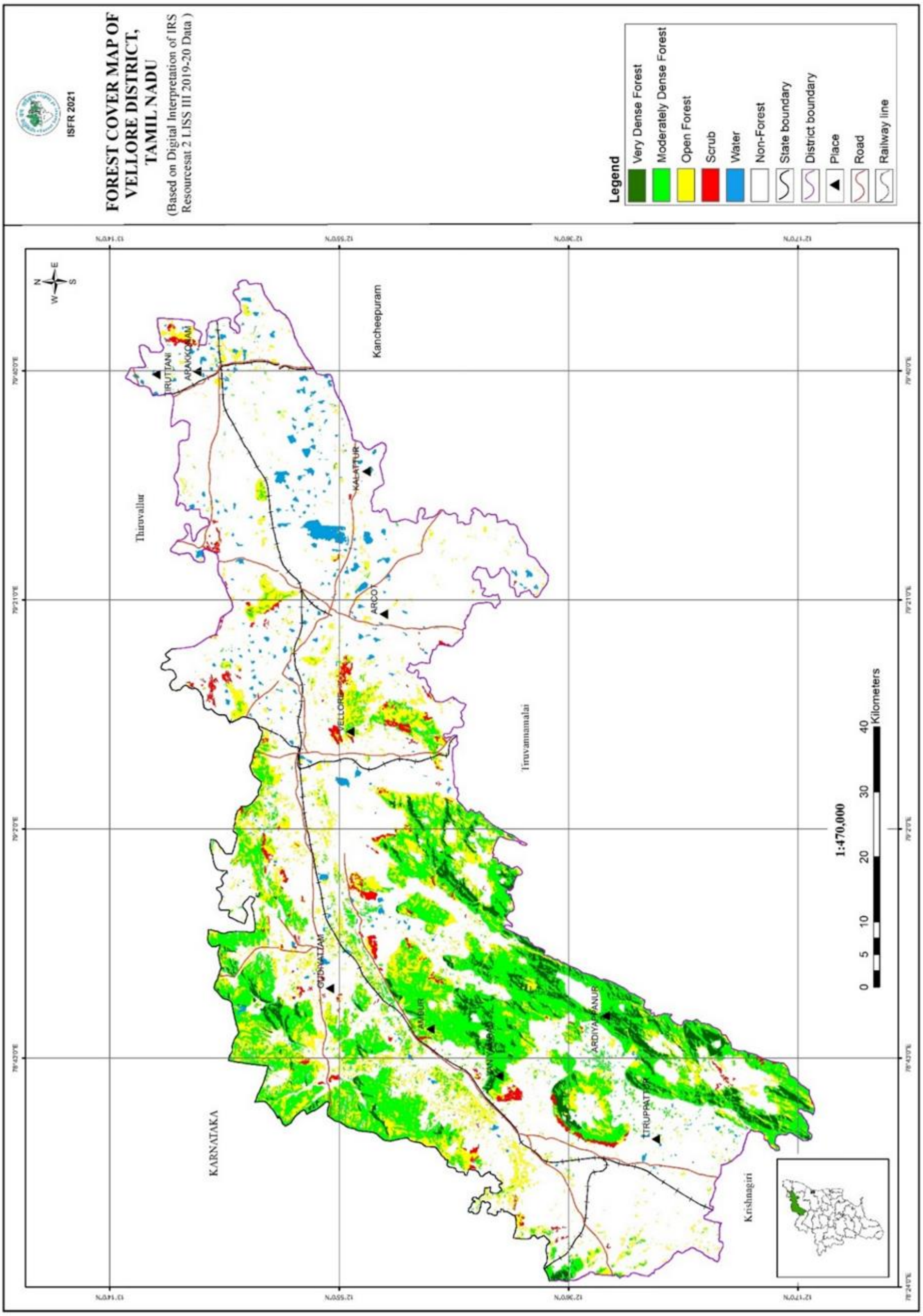
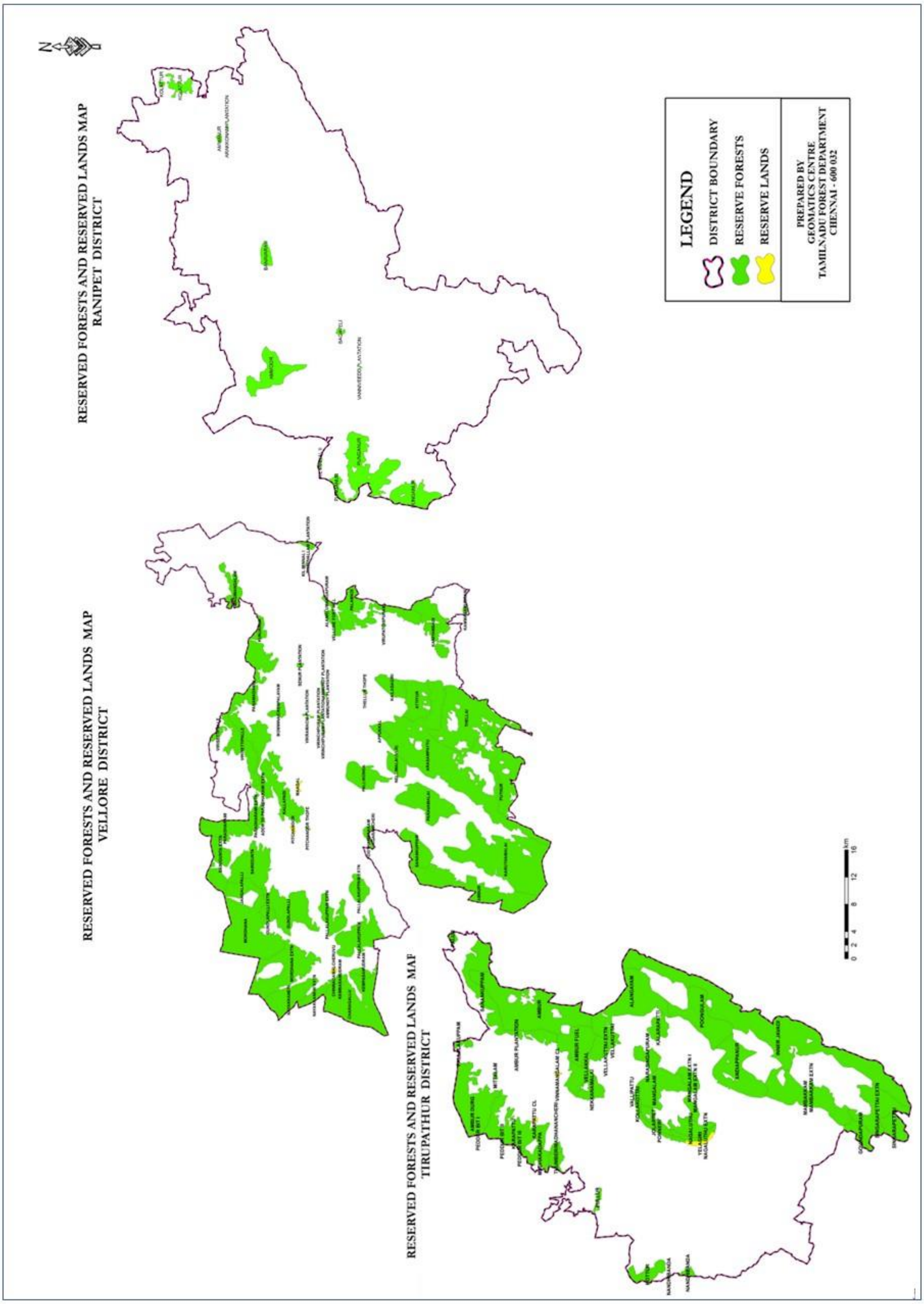


Figure 8.30.4. Map of Notified forests in Vellore district



31. VILLUPURAM

Villupuram is a coastal district located towards the north eastern side of the state. The district was one of the largest in terms of total geographical area which was 7194 sq.km. Recently the district got bifurcated into two districts – Villupuram with the coastal region and Kallakurichi with some parts of the Eastern Ghats Kalrayan hills. However, the bifurcation of Villupuram has not yet been considered by the ISFR 2021.Despite having some parts of Eastern Ghats within the geographical area of Villupuram, the total forest cover area has been only 834.35 sq.km. which constitutes 11.6% of the total geographical area. The Recorded Forest Area(RFA) is 1264.4 sq.km. which includes the area of 69 reserved forests, 20 reserved lands and about 400 sq.km. of unclassified forest lands. The fact that the total forest cover area is lesser than the recorded forest area, clearly indicates that the canopy density of the forest within the Recorded Forest area is very less. This is a major concern, studies must be initiated to assess the canopy density of the recorded forest area, identify the reason that affects the canopy density and suggest methods to increase it within the RFA. All three density classes are available in this district. The dense forest category has shown a steady increase from 27 sq.km. to about 80 sq.km. during the period 2003 to 2021. But the moderately dense forest category has recorded decreasing trend steadily from 431 to 299.05 sq.km. in 2021. Similarly, the open forest area has also been steadily decreasing from 2003 (598 sq.km) to 2021 (455.94 sq.km.). The decrease in the area of the moderately dense forest and open forest has contributed to the steady decrease in the total forest cover of this district. There has been a loss of about 220 sq.km. between 2003 and 2021. The total forest cover area percentage has decreased from 14.69% to 11.6%. It's a serious concern because if this trend continues in the same pace, there would be a heavy loss of forests in Villupuram. Measures to increase the canopy density within the forest and also to reach the masses to encourage them to come forward for the tree plantation drives should be taken up immediately.

Table 8.31.1: Villupuram Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	7190	7190	7190	7190	7190	7190	7194	7194	7194
VDF	27	27	70	70	70	71	80	79.48	79.36
MDF	431	430	370	370	331	272	300	301.56	299.05
OF	598	576	571	569	582	510	466	476.52	455.94
TFCA	1056	1033	1011	1009	983	853	846	857.56	834.35
Percent	14.69	14.37	14.06	14.03	13.67	11.86	11.76	11.92	11.6
Change	-42	7	5	-2	-26	-130	0	11.56	-23.21
Scrub	166	38	20	21	23	27	44	46.44	47.01

Figure 8.31.1. Trend analysis of forest in Villupuram district

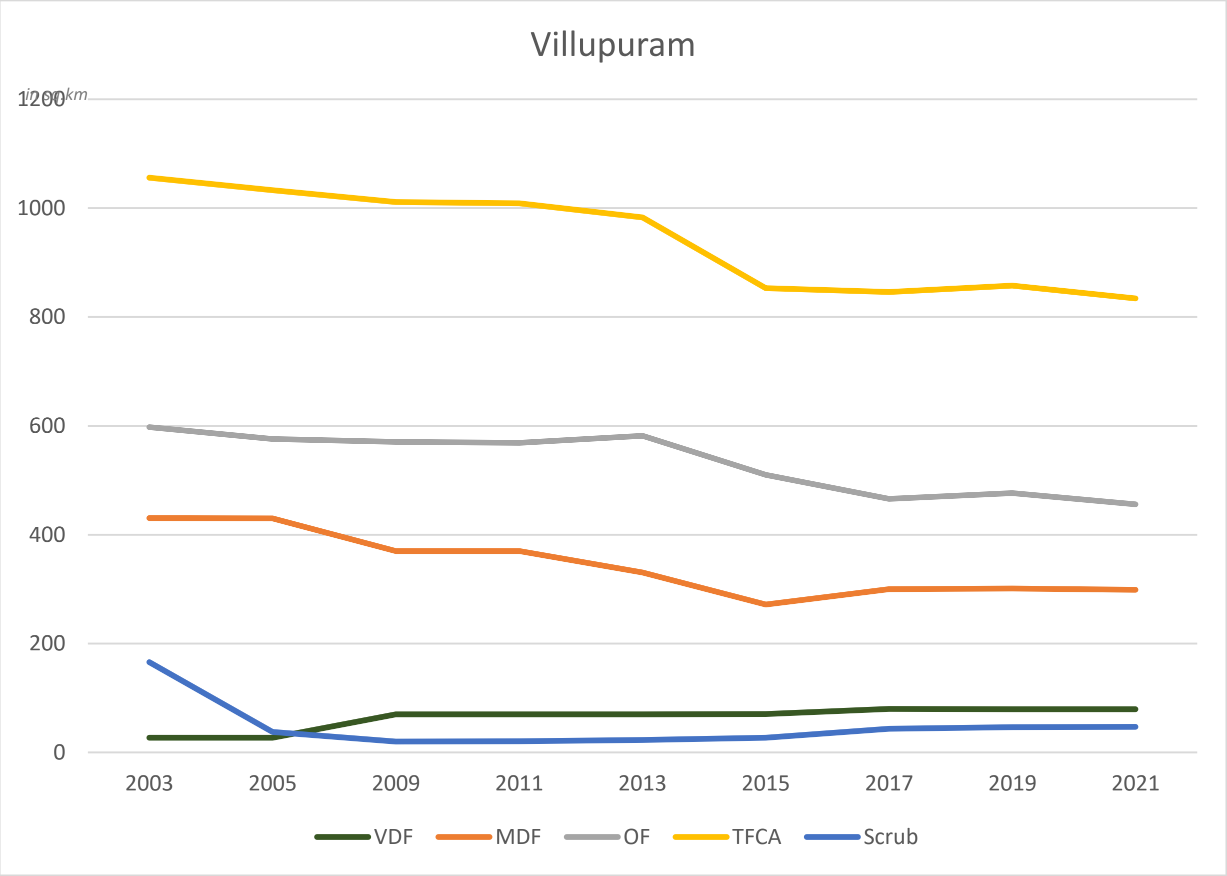


Figure 8.31.2. Share of Forest & non-forest area in Villupuram district (2021)

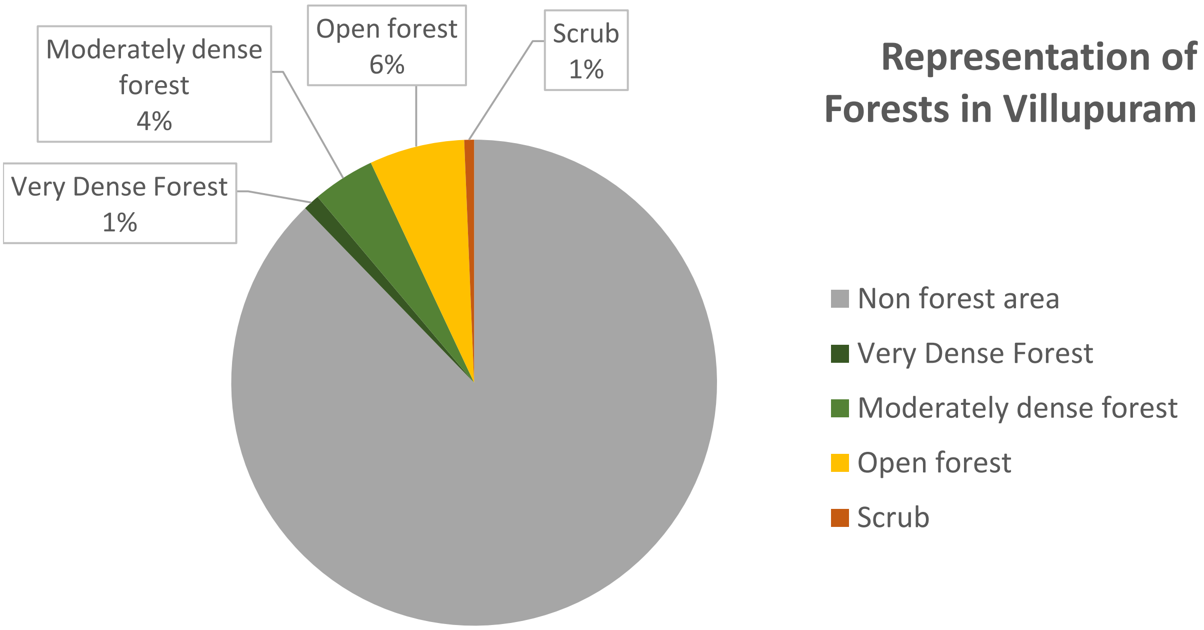


Figure 8.31.3. Forest Cover map of Villupuram district

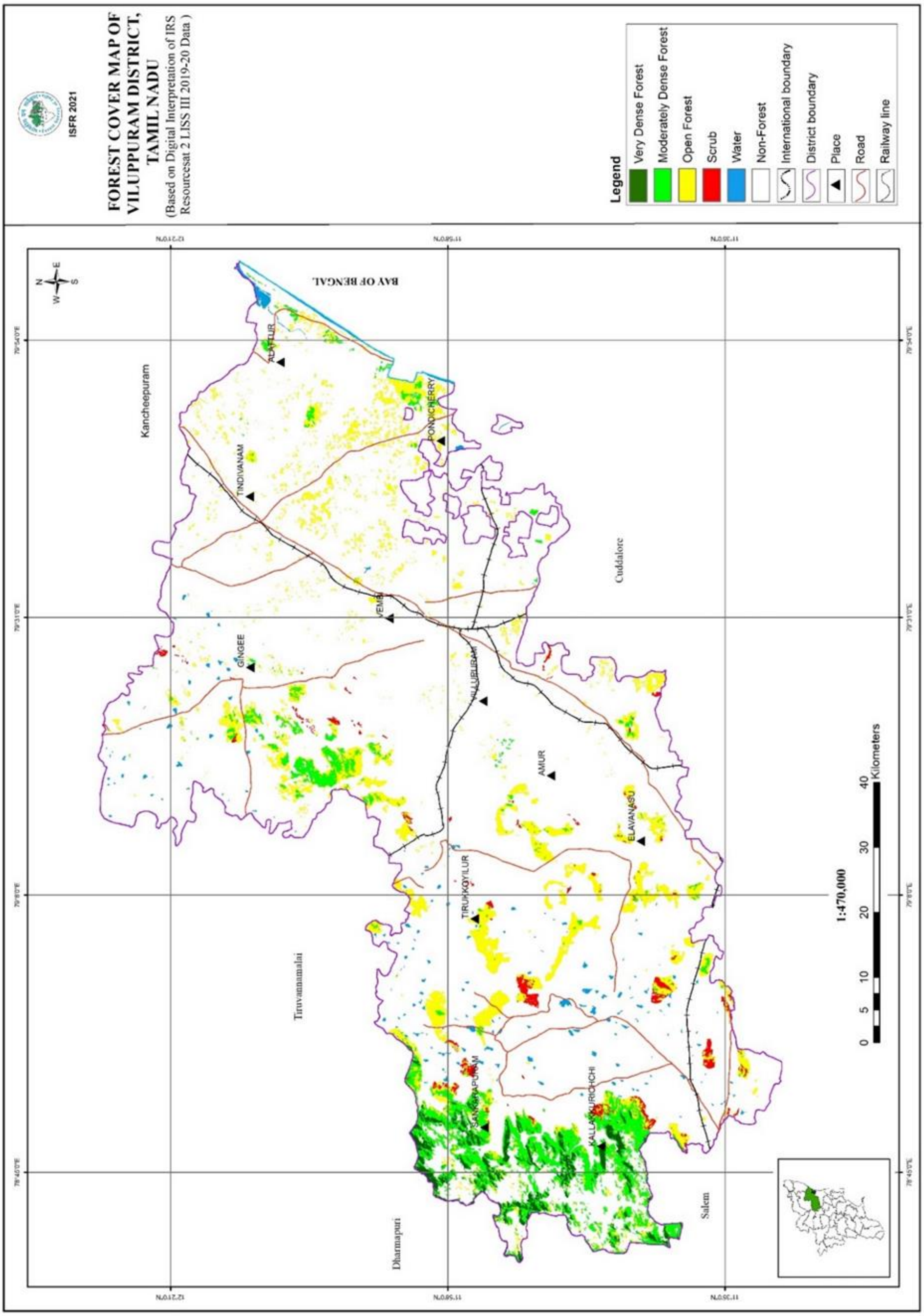
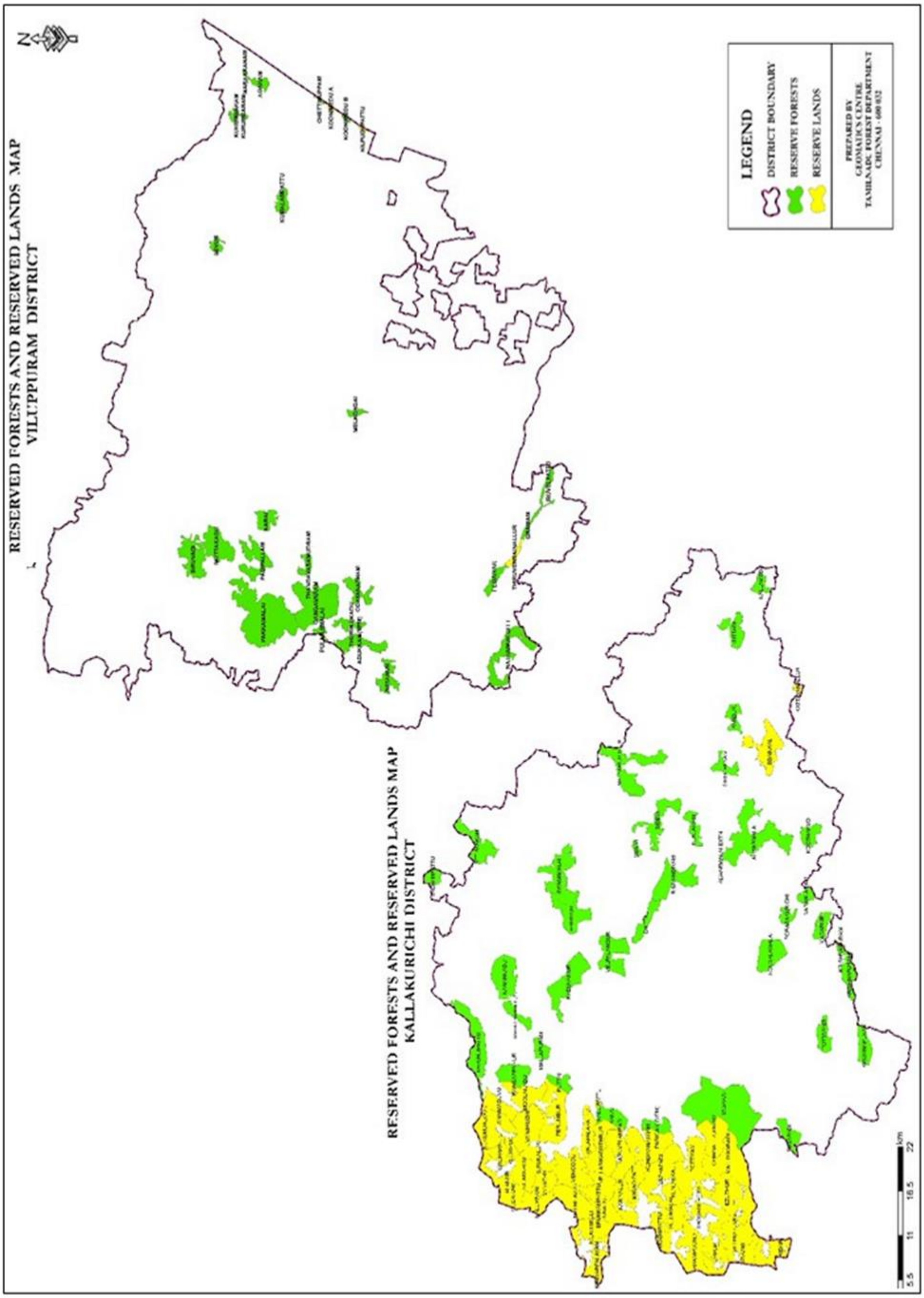


Figure 8.31.4. Map of Notified forests in Villupuram district



32. VIRUDHUNAGAR

Virudhunagar district is located south of Madurai district with some parts partially covered with the Western Ghats while most regions are dry due to the interior location far away from the coast. The total geographical area is 4241 sq.km. out of which the total forest cover area is estimated to be 341.62 sq.km. i.e only 8.06% of total geographical area. The recorded forest area in Virudhunagar is 491.15 sq.km. with 27 reserved forests. The fact that the total forest cover area is less than the recorded forest area, clearly indicates that the canopy density within the recorded forest is very less. This is a major concern; studies must be initiated to assess the canopy density within the recorded forest area.

All three density classes are present in this district of which dense forest has shown a steady decrease in the extend from its value of 54 sq.km. to 38.74 sq.km. Though the trend has been of rapid decrease till 2009 followed by gradual increase up to 2017. With respect to the moderately dense forest category, there has been a good increase in the area until 2013 and then on it was in decreasing trend to reach 130.3 sq.km. in 2021. The open forest category of forests has also recorded sharp fall until 2013 and then a sharp increase in 2015 followed by gradual decrease. The total forest cover area has also been varying largely every year with the highest value recorded in 2015 as 469 sq.km. and the latest report recorded it as 341.62 sq.km. Special focus to identify the reason for the large variations in the values of the total forest cover area must be initiated. There is a need to work hard to increase the district's tree cover as the present value of the forest cover is very low with only 8.06% of total geographical area.

Table 8.32.1: Virudhunagar Forest density classes distribution over the years

Unit in sq.km

Parameters	2003	2005	2009	2011	2013	2015	2017	2019	2021
TGA	4283	4283	4283	4283	4283	4283	4241	4241	4241
VDF	54	54	29	29	29	36	40	38.74	38.74
MDF	139	137	186	182	184	170	131	133.18	130.3
OF	136	133	74	69	88	263	159	174.62	172.58
TFCA	329	324	289	280	301	469	330	346.54	341.62
Percent	7.68	7.56	6.75	6.54	7.03	10.95	778	8.17	8.06
Change	18	0	2	-3	21	168	0	16.54	-4.92
Scrub	232	12	17	14	15	1	5	7.6	8.94

Figure 8.32.1. Trend analysis of forest in Virudhunagar district

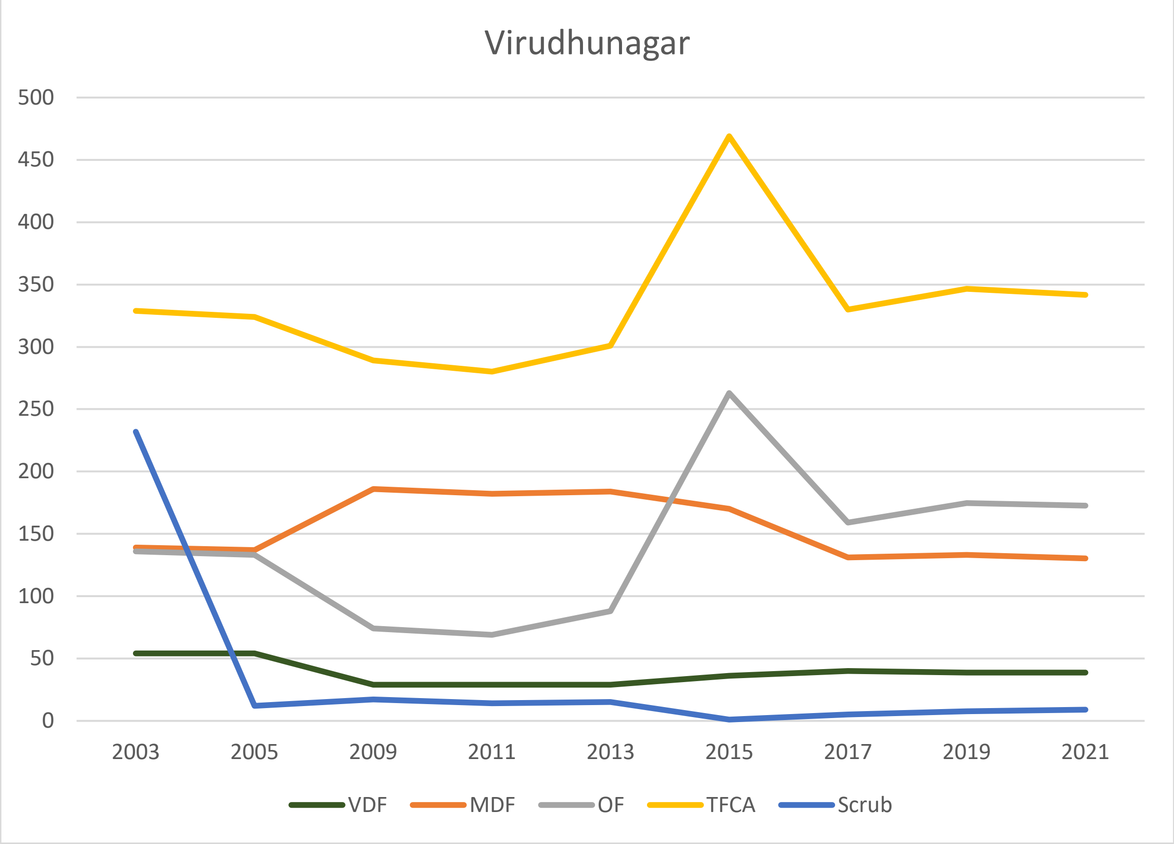


Figure 8.32.2. Share of Forest & non-forest area in Virdhunagar district (2021)

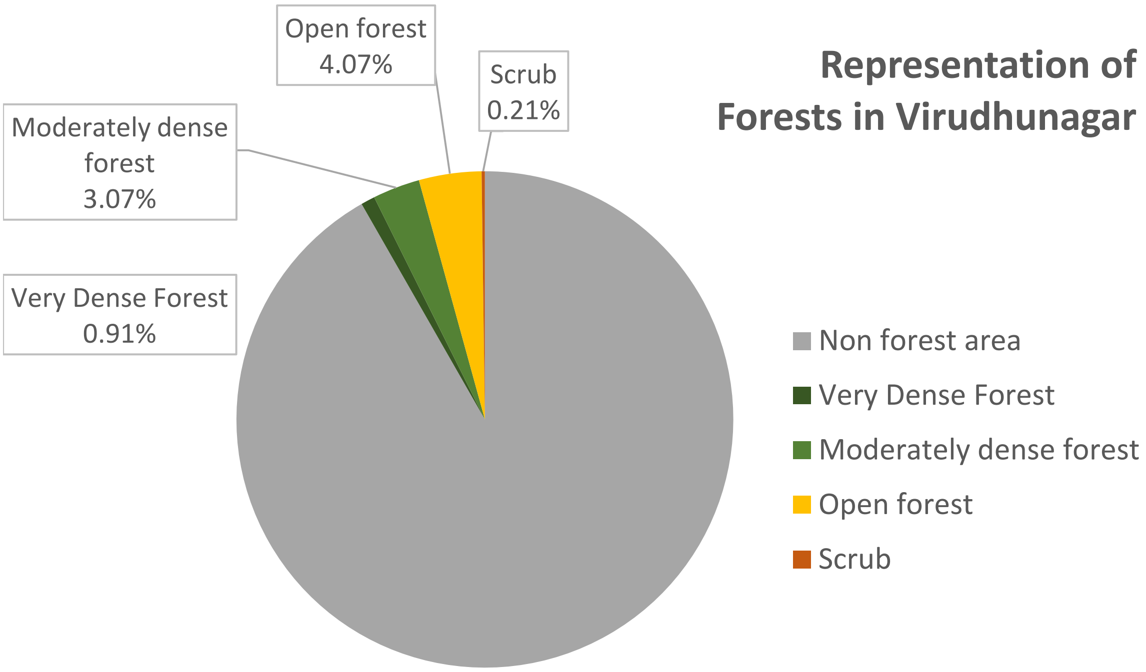


Figure 8.32.3. Forest Cover map of Virudhunagar district

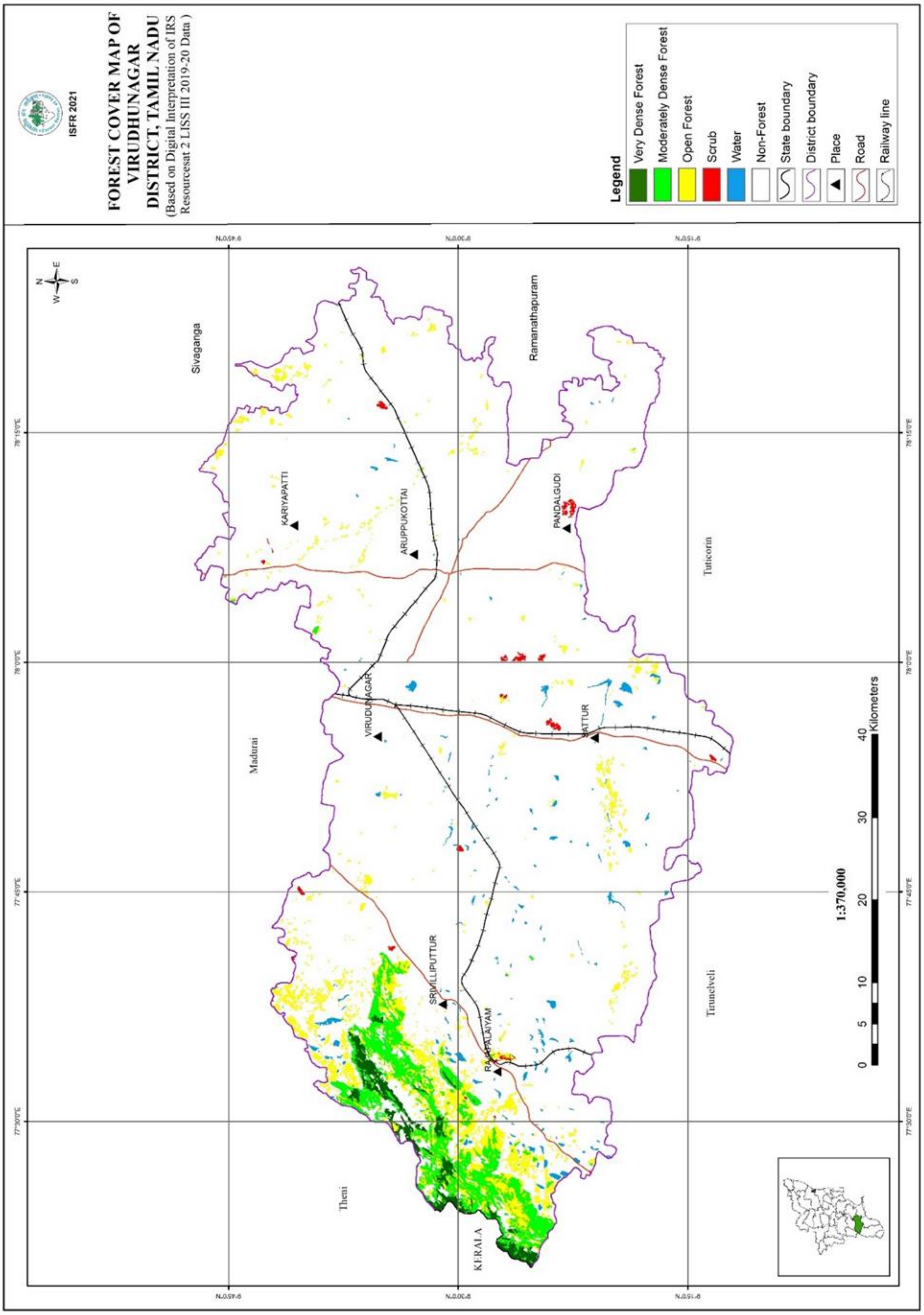
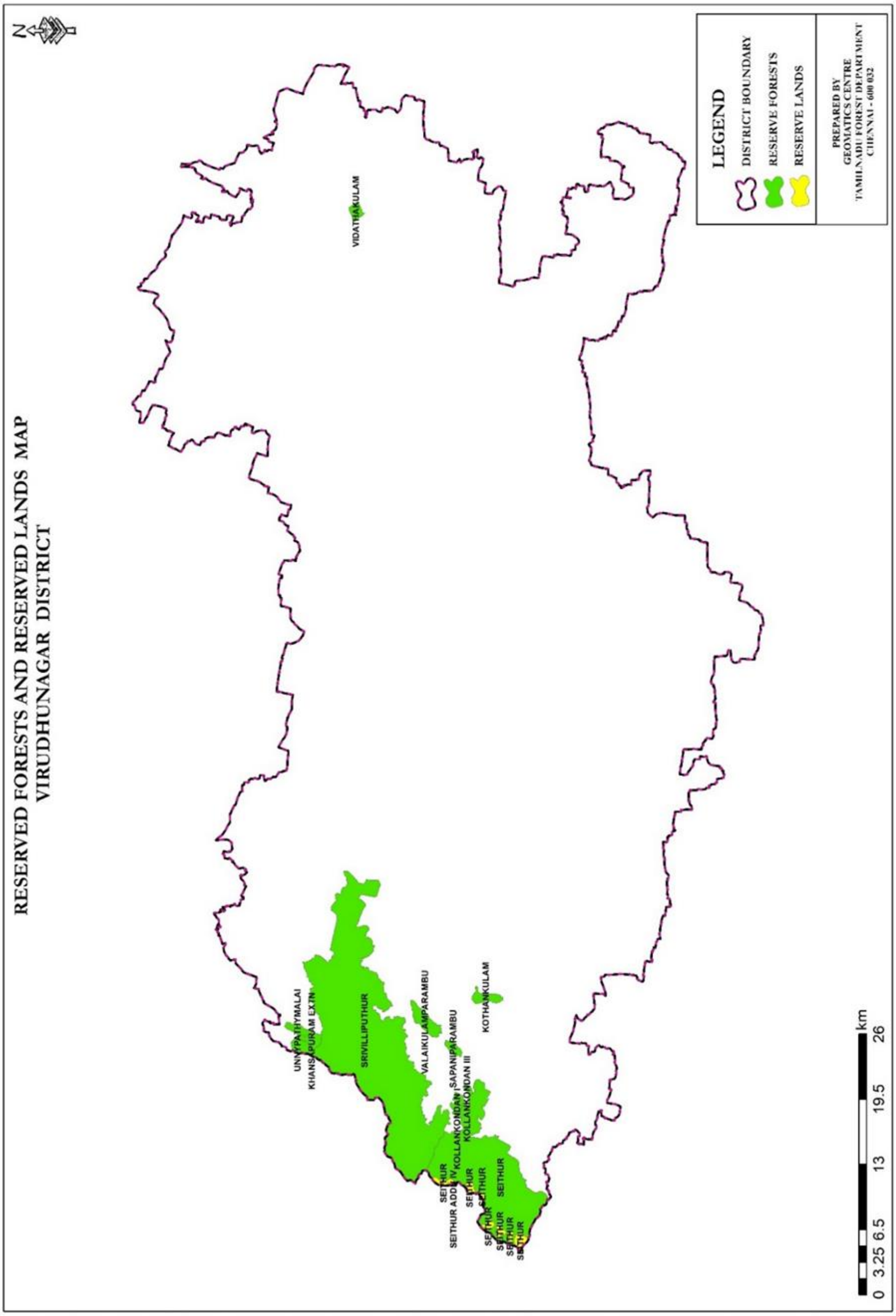


Figure 8.32.4. Map of Notified forests in Virudhunagar district



9. SUMMARY

9.1 Forest Cover

The Report has analyzed and discussed the present forest cover (based on ISFR 2021) and the trends in forest cover levels for the past two decades. The districts that have very less percentage of forest cover and the districts that have recorded loss in forest cover over time are identified as 'priority districts'. Policy focus should therefore be on improving their forest cover in the upcoming years. Attention has to be particularly given to districts that have very less forest cover in terms of area – which are – Chennai, Tiruvarur, Karur, Nagapattinam, Perambalur. These five districts contribute only 1.89% towards the state's total forest cover. There are 12 districts which have very less forest cover i.e less than 10% of its total geographical area and 8 districts have low forest cover (10 – 20% of total geographical area). The following table classifies the district based on the percentage of its forest cover area.

Table 9.1: Overview on Forest Cover classification in Tamil Nadu districts

% of Forest Cover	Class	Number of Districts
>33%	High Forest Cover	6
20-30%	Moderate Forest Cover	6
10-20%	Low Forest Cover	8
0-10%	Very Less Forest Cover	12

Table 9.2: Classification of districts by total forest cover area

S.No	District	Geographical area (in sq.km)	Total forest cover area ISFR 2021 (in sq.km)	% of Forest cover	Class
1	Tiruvarur	2274	70.07	3.08	Very Less Forest Cover
2	Karur	2904	118.64	4.09	Very Less Forest Cover
3	Thoothukudi	4745	251.97	5.31	Very Less Forest Cover
4	Nagapattinam	2569	156.68	6.1	Very Less Forest Cover
5	Ramanathapuram	4104	251.49	6.13	Very Less Forest Cover
6	Chennai	175	12.67	7.24	Very Less Forest Cover
7	Kancheepuram	4483	325.31	7.26	Very Less Forest Cover
8	Sivagangai	4233	331.09	7.82	Very Less Forest Cover
9	Virudhunagar	4241	341.62	8.06	Very Less Forest Cover
10	Perambalur	1756	142.17	8.1	Very Less Forest Cover
11	Pudukkottai	4644	377.13	8.12	Very Less Forest Cover

12	Thiruvallur	3394	295.52	8.71	Very Less Forest Cover
13	Thanjavur	3411	350.34	10.27	Low Forest Cover
14	Cuddalore	3703	390.24	10.54	Low Forest Cover
15	Tiruchirapalli	4509	475.82	10.55	Low Forest Cover
16	Villupuram	7194	834.35	11.6	Low Forest Cover
17	Madurai	3710	553.22	14.91	Low Forest Cover
18	Tirupur	5187	846.19	16.31	Low Forest Cover
19	Namakkal	3420	580.89	16.99	Low Forest Cover
20	Tirunelveli	6693	1302.5	19.46	Low Forest Cover
21	Ariyalur	1940	404.6	20.86	Moderate Forest Cover
22	Tiruvannamalai	6188	1312.35	21.21	Moderate Forest Cover
23	Salem	5237	1471.12	28.09	Moderate Forest Cover
24	Vellore	6075	1824.98	30.04	Moderate Forest Cover
25	Dindigul	6036	1877.97	31.11	Moderate Forest Cover
26	Krishnagiri	5129	1617.95	31.55	Moderate Forest Cover
27	Dharmapuri	4497	1702.71	37.86	High Forest Cover
28	Erode	5760	2295.73	39.86	High Forest Cover
29	Theni	2868	1183.89	41.28	High Forest Cover
30	Coimbatore	4732	1985.04	41.95	High Forest Cover
31	Kanyakumari	1684	1003.6	59.6	High Forest Cover
32	The Nilgiris	2565	1731.38	67.5	High Forest Cover

In order to identify the districts that have lost forest cover during the period 2001 to 2021, the average of the total forest cover area in the two decades (2001 to 2011 and 2011 to 2021) was taken and the change in percentage calculated. The following six districts have lost its forest cover during these two decades.

Districts where forest cover reduced in the past two decades	Sivagangai	-20.47%	The reason for the loss of the forest cover of these 6 districts must be identified. These districts have to be closely monitored and special attention to improve the tree cover has to be given. Studies have to be commissioned to identify the reasons for loss and specialised strategies to address those factors to be formulated.
	Villupuram	-13.85%	
	Kancheepuram	-13.03%	
	The Nilgiris	-9.32%	
	Cuddalore	-4.48%	
	Tiruvannamalai	-0.22%	

Districts that have less than 10% of increase in Forest cover	Erode	3.78%	Though these 6 districts have performed better in increasing its forest cover marginally, with more attention in terms of special schemes or plantation drives, there is a possibility that these districts will be able to improve its forest cover percentage.
	Perambalur	4.34%	
	Namakkal	5.54%	
	Ramanathapuram	5.78%	
	Vellore	7.79%	
	Dharmapuri	9.22%	

9.2 Recorded Forest Area

The Report has also analyzed the differences, if any, between the Recorded Forest area and forest cover area estimated by FSI for Tamil Nadu (Chapter 5). This comparison indicates the status of the forest within the notified forest area and the status of the tree cover outside forest. In some districts, the recorded forest area was observed to be more than the total forest cover area while it was the reverse in the other districts. To summarize and to identify the districts that require more attention to improve its canopy density (tree cover) within the notified forests and those districts which must focus on improving its tree cover outside forest, the recorded forest area obtained from the Tamil Nadu Forest Department (2021 data) was compared with the total forest cover area estimated in ISFR 2021.

<table>
<tr><td rowspan="8">Districts where recorded forest area is more than the total forest cover area (based on 2021 data)</td><td>Villupuram</td><td rowspan="8">In these 8 districts, the recorded forest area is more than the TFCA which indicates that there are portions of the notified forest, tree density of which do not contribute to the forest cover of the district. So, attention should be given to improve the tree cover within the forest areas. Studies through remote sensing can be used to identify the areas where the tree density is poor and strategies to be developed to take up measures to improve the tree cover.</td></tr>
<tr><td>Virudhunagar</td></tr>
<tr><td>Tiruvannamalai</td></tr>
<tr><td>Tirunelveli</td></tr>
<tr><td>Tiruvarur</td></tr>
<tr><td>The Nilgiris</td></tr>
<tr><td>Perambalur</td></tr>
<tr><td>Nagapattinam</td></tr>
</table>

<table>
<tr><td rowspan="11">Districts which require attention to increase the TOF (Tree Outside Forest)</td><td>Chennai</td><td rowspan="11">All these districts have only very small areas under the ‘TOF' which can be inferred from the value of the TFCA which is only slightly more than the recorded forest area. Studies using remote sensing can help to identify the fallow land patches where tree planting can be initiated based on the soil parameters. Extension activities promoting agro-forestry, road side planting, farm forestry, urban parks etc has to be initiated.</td></tr>
<tr><td>Trichy</td></tr>
<tr><td>Erode</td></tr>
<tr><td>Theni</td></tr>
<tr><td>Vellore</td></tr>
<tr><td>Dharmapuri</td></tr>
<tr><td>Karur</td></tr>
<tr><td>Namakkal</td></tr>
<tr><td>Kancheepuram</td></tr>
<tr><td>Sivaganga</td></tr>
<tr><td>Tiruvallur</td></tr>
</table>

<table>
<tr><td rowspan="8">Districts where canopy density within the RFA (Recorded Forest Area) has to be improved</td><td>Krishnagiri</td><td rowspan="8">In all these districts, the TFCA is more than the recorded forest area. This indicates that the trees outside forest area is more in these districts and contributes substantially to the district’s forest cover. So, measures have to be taken up at two different levels,
1. Assessment of tree cover (canopy density) within the recorded forest area has to be done using geo-spatial technologies. In areas where the tree cover is less,</td></tr>
<tr><td>Thoothukudi</td></tr>
<tr><td>Pudukkottai</td></tr>
<tr><td>Salem</td></tr>
<tr><td>Ramanathapuram</td></tr>
<tr><td>Madurai</td></tr>
<tr><td>Cuddalore</td></tr>
<tr><td>Dindigul</td></tr>
</table>

	Ariyalur	measures should be taken to increase the canopy density in line with the existing natural habitat. 2. The unclassified lands have to be notified at the earliest possible and protection measures strengthened to protect the existing tree resources in these lands.
	Thanjavur	
	Kanyakumari	
	Tirupur	
	Coimbatore	

The data on the recorded forest area (**as** on Dec 2021 obtained from TNFD) and the total forest cover area of the 32 districts is compared in the table 9.3.

Table 9.3: Recorded Forest area and total forest cover area in the districts of Tamil Nadu

S.No	District	Recorded Forest Area (in sq.km)	Total Forest Cover Area 2021	S.No	District	Recorded Forest Area (in sq.km)	Total Forest Cover Area 2021
1	Ariyalur	91.3754	404.6	17	Ramanathapuram	47.0747	251.49
2	Chennai	7.4900	12.67	18	Salem	1284.3465	1471.12
3	Coimbatore	1427.5504	1985.04	19	Sivagangai	239.0437	331.09
4	Cuddalore	99.5039	390.24	20	Thanjavur	10.3959	350.34
5	Dharmapuri	1654.9822	1702.71	21	The Nilgiris	1754.1133	1731.38
6	Dindigul	1582.4822	1877.97	22	Theni	1168.7357	1183.89
7	Erode	2282.4692	2295.73	23	Tiruvannamalai	1455.7030	1312.35
8	Kancheepuram	236.2820	325.31	24	Tiruvarur	120.7093	70.07
9	Kanyakumari	642.0592	1003.6	25	Thoothukudi	108.1231	251.97
10	Karur	67.4904	118.64	26	Tirunelveli	1403.3704	1302.5
11	Krishnagiri	1492.8782	1617.95	27	Tirupur	458.3780	846.19
12	Madurai	290.8348	553.22	28	Tiruvallur	201.7762	295.52
13	Nagapattinam	160.1986	156.68	29	Trichy	464.8370	475.82
14	Namakkal	505.7028	580.89	30	Vellore	1790.0913	1824.98
15	Perambalur	163.3052	142.17	31	Villupuram	1264.3700	834.35
16	Pudukkottai	221.2207	377.13	32	Virudhunagar	491.1485	341.62

As the total forest cover area in Tamil Nadu is more than the recorded forest area, measures and initiatives must be taken up immediately to increase the forest cover within the recorded forest area. This is crucial because such measures will improve the quality of the forest and the growing stock within the recorded forest area which act as habitat for the wild animals. Availability of adequate fodder and water resources within the forest area will reduce the animal straying outside the forest, thus resulting in less human – wildlife conflict.

9.3 Density Classes

IFSR 2001 – had only two density classes – Dense Forest and Open Forest, and it was only from IFSR 2003, Forest Survey of India came up with three density classes – Very Dense Forest (VDF), Moderately dense forest (MDF) and open forest (OF). So, for the purpose of comparison, the three density classes data from 2003 are used.

Since 2003, the VDF category has increased from 10.78% to 13.60% in 2021, MDF has reduced from 42.25% to 41.77%, open forest has reduced from 46.97% to 44.63% - which indicates that the state as a whole has been progressing well in improving the quality of the forest.

Overall, all the three density classes of the forest cover have shown increase in terms of the total area between 2003 and 2021. But it is more important to analyze the variations of each of these classes in the districts in order to understand and identify the districts where forests have been vulnerable to threats during this period. Accordingly, the following section summarizes and provides the list of districts that needs more attention with respect to the specific density classes of the forest that are under threat.

<table>
<tr><td rowspan="9">Districts which require attention with respect to the dense forest category</td><td>Nilgiris</td><td rowspan="9">All these districts have recorded loss in the dense forest area during some point in the past two decades. Nilgiris had a loss of 226 sq.km between 2003-2011 followed by Dharmapuri with a loss of 99 sq.km during 2011-2021. On comparing the net loss between 2003 to 2021, Tiruchirapalli and Virudhunagar are the two districts that have lost dense forest to the extent of 15 sq.kms.</td></tr>
<tr><td>Dindigul</td></tr>
<tr><td>Erode</td></tr>
<tr><td>Tiruchirapalli</td></tr>
<tr><td>Theni</td></tr>
<tr><td>Perambalur</td></tr>
<tr><td>Kanyakumari</td></tr>
<tr><td>Coimbatore</td></tr>
<tr><td>Virudhunagar</td></tr>
</table>

<table>
<tr><td rowspan="10">Districts which require attention with respect to the moderately dense forest category</td><td>Nilgiris</td><td rowspan="10">During 2011-2021, 15 districts have reported losses in moderately dense forest. Among them, the districts that have lost more than 50 sq.km are – Nilgiris (348 sq km), Erode (242 sq kms), Tirunelveli (193 sq.km), Cuddalore (170 sq.km), Villupuram (70 sq.km), Madurai (60 sq.km), Ramanathapuram (56 sq.km) and Kancheepuram (51 sq. km)

Four districts have recorded loss in two successive decades i.e change in area between 2011 & 2003 and 2021 & 2011. The 4 districts are – Ramanathapuram, Sivagangai, Thiruvallur and Villupuram.</td></tr>
<tr><td>Erode</td></tr>
<tr><td>Tirunelveli</td></tr>
<tr><td>Cuddalore</td></tr>
<tr><td>Villupuram</td></tr>
<tr><td>Madurai</td></tr>
<tr><td>Ramanathapuram</td></tr>
<tr><td>Sivagangai</td></tr>
<tr><td>Thiruvallur</td></tr>
<tr><td>Kancheepuram</td></tr>
</table>

Districts which require attention with respect to the **open forest category**	Nilgiris Villupuram Dharmapuri Vellore Tiruvannamalai Tirunelveli Sivagangai Kancheepuram Virudhunagar	During 2011-2021, 6 districts have lost more than 50 sq. km of area of the open forest area – Dharmapuri (409 sq.km), Vellore (235 sq.km), Tiruvannamalai (190 sq km), Nilgiris (147.8 sq km), Villupuram (142 sq km) and Tirunelveli (53.54 sq. km) Loss of open forest area of 5 districts has contributed to the loss in the total forest area of that district during period 2003 -2021 in the following districts – Nilgiris, Villupuram, Kancheepuram, Sivagangai and Tiruvannamalai. Nilgiris and Villupuram have lost a large extent of open forest area that has led to the loss in the district's total forest cover area too. A detailed study to identify the factors that has led to this loss has to be initiated immediately.

The table below lists out the districts and the density class of forest that requires immediate attention and close monitoring.

Table 9.4: Districts and the density class that requires attention

District	Dense forest	Moderately dense forest	Open forest
Nilgiris			
Villupuram			
Erode			
Sivagangai			
Virudhunagar			
Tirunelveli			
Kancheepuram			
Dindigul			
Tiruchirapalli			
Theni			
Perambalur			
Kanyakumari			
Coimbatore			
Cuddalore			
Madurai			
Ramanathapuram			
Thiruvallur			
Dharmapuri			
Vellore			
Tiruvannamalai			

9.4 Tree Cover

There is a steady decrease in the tree cover of the state from 2001 to 2021 to an extend of 1630 sq. km during this period, but the total forest cover area of the state during this period has increased by many folds. This indicates that the contribution of large green patches (more than 1 hectare of area) has steadily increased but the state has lost about 1630 sq.km of the smaller patches of trees or groves (less than 1 ha) outside the recorded forest area. This may be due to several reasons like urbanization, increasing developmental activities, cyclones, drought, linear developments etc., The State Government has to closely monitor the smaller green patches that exist outside the recorded forest area. If possible, mapping of these smaller green patches and a temporal analysis can also be carried out using high resolution satellite images to identify those patches that have lost its tree cover.

9.5 Mangrove Cover

The share of Tamil Nadu's mangrove to the national mangrove cover is only 0.9%. Despite the very less extent of mangrove in the state in comparison to the other states, Tamil Nadu has shown an increasing trend in the area of the mangrove cover from 23 sq.km. in 2001 to 49 sq.km in 2017. But the state had lost 4 sq.km of the mangrove cover between 2017 and 2021. Among the districts, the following are the identified as 'focus districts' with respect to the mangroves based on the analysis during the period 2001 and 2021,

- Nagapattinam has recorded a huge loss of about 17 sq kms of mangroves
- Pudukkottai has 1 sq.km of very dense mangrove which requires protection and conservation, the district has also lost some amount of the open mangrove class.
- Cuddalore has lost about 1 sq.km of the mangrove patch
- Ramanathapuram has lost a portion of very dense, moderate and open mangrove classes.
- Tiruvallur has Ennore creek, which has improved its density during the decade 2011-21, however this requires more protection to improve on its density.
- Tiruvarur district has about 12.8 sq.km of mangroves, but due to some reasons, the extend reduced to 12.8 sq.km in 2019 and 2021. The reason for this loss requires a detailed study and analysis based on which corrective measures can be initiated.

The Report therefore concludes with a list of action points for policy attention to strengthen the forest cover across the districts in Tamil Nadu.

10. DISCUSSIONS & WAY FORWARD

Considering the crucial role the forests play in ecological stability, socio-economic wellbeing and development of a country, the National Forest Policy aims at having a minimum of one-third of its geographical area under forest and tree cover. In the hills and mountainous regions of the country, this proportion has been targeted at two-thirds. Tamil Nadu also has a similar vision. It aims at achieving 33% of green cover by 2031.

In order to achieve this massive target, the state had come up with a flagship mission named "Green Tamil Nadu Mission". But it is understandable that not all the area under the recorded forest area should necessarily have good forest cover because forest area also includes rocks, deserts and dry lands etc., Therefore, unless one has information on area having forest and tree cover, it cannot be said with certainty of how much more area should be brought under forest and tree cover to achieve the goal of 33%. This report has attempted to address this requirement of identifying the districts which requires special attention to increase its forest cover within the forest area and those districts where the focus has to be on the TOF.

The India State of Forest Report prepared by Forest Survey of India is used as a major source of information to carry out this analysis with respect to the state's forest cover and other related parameters. The information presented in the ISFR is used as the primary information on different parameters of the forest resources in Tamil Nadu for this analysis. Other than the details on forest and tree cover, ISFR also comments about the growing stock and carbon stock. India State of Forest Report states that Tamil Nadu has suffered severe degradation in its growing stock between the years 2011 and 2021 with a loss of growing stock of 52.134 m.cu.m in the Recorded Forest Areas which is a cause of great concern and should be addressed scientifically followed by practical solutions to address this concern.

Conducting this detailed analysis on the forest cover in Tamil Nadu was to know the status of the present forest, to see the changes it had undergone, to identify the priority areas, to guide policy and decision-making, and to recommend sustainable forest management practices to address the issues. The findings of this analysis under each section are a vital information that is required for policy formulation, planning and management of forests at the state and the district level. The analysis done at the district level has identified the priority districts which needs attention and scientific intervention to improve its green cover. This report also provides detailed analysis on the Mangrove Cover, Tree Cover, variations in Density classes of forest and the recorded forest area. Still, there is a good scope for wider analysis by integrating the data that is available in the IFSR and the

spatial satellite image analysis. The findings of this analysis are believed to be helping the concerned departments and district administration in planning their programs and schemes. Suggestions to address the highlighted issues specific to the district or any particular class of forest are given below.

1. **Agro-forestry**

   Tree growing on the farm lands offers a tremendous opportunity for the farmers to supplement their income in addition to the agricultural crops. It also contributes to the green cover of the state and the respective district as it is considered as 'Tree Outside Forest'. It is high time that the consistent efforts are taken to increase the tree cover on the farm lands and built up the robust data base on the farmers and the growing stock in their land. This will also help in benefitting the tree growing farmers by enhancing their livelihood opportunities.

2. **Restoration of degraded Forest**

   The restoration of degraded forest lands in the State shall be under taken for improving the growing stock and carbon sequestration potential in the natural forests. The detailed discussions in the assessment report shows that in most districts the recorded forest area contributes less to the green cover which in turn reflects on condition of the forest land. So, restoration of the degraded forest land with a focused approach by integrating the tree planting with soil moisture conservation works based on the soil assessment shall be taken up. The mission document of the Green Tamil Nadu Mission states that it is pertinent that ecological restoration of minimum 4500 sq km out of there 11,725 sq km of open degraded forests and Scrubs forests of 715 sq km shall be instrumental in enhancing the ecological security of the State in terms of sound mitigation and adaptation measures for meeting the growing challenges of the Climate Change. Measures should be taken to improve the remaining areas of the open degraded forest and scrub lands through dedicated schemes and focused approach.

3. **Community Participation**

   Forest Land Restoration (FLR) with the participation of the indigenous and local communities has to be given priority. It has been duly recognized nationally and globally that the Forest Land Restoration is a vital tool in the hands of the Government to achieve the Land Degradation Neutrality (LDN) within the forest areas. FLR has gained greater significance in the recent past since it facilitates climate change mitigation and adaptation. The restorative practices have proved to enhance the quality of life of local communities particularly the indigenous communities by the way of enriching the biodiversity and increasing non -timber forest produces.

4. Mission Mode of operation

ISFR data reveals that Telangana has increased the forest cover in all the density classes. Probably it was because of the 'Haritha Haram Scheme' of the Government of Telangana. 230 crores of seedlings were planted under the above greening scheme wherein 100 crores of in-situ (root stock) were raised through assisted natural regeneration within the recorded forest areas of Telangana State. A similar mission mode of operation is required in Tamil Nadu. Green Tamil Nadu mission is expected to cater to this need. Periodical Monitoring and evaluation can help to identify the gaps and address them at the initial stage. Spatial analysis has to be carried out to identify the potential planting zones followed by scientific tree planting and follow up to ensure its survival.

5. Mapping of SDG and Climate action with greening goals

SDG 15 – "Life on Land" has indicators on forest and tree cover. As per the SDG India index 2020-21 prepared by NITI AAYOG, the State of Tamil Nadu has not been progressing in SDG 15 when compared to its performance and progress in other SDGs like SDG no 1,2,3,5,7,9. Despite several afforestation and biodiversity conservation being implemented in the State in the past decade, the State stands at no 14 out of 22.

The reason which has pulled down the performance of the State in the SDG no 15 (Life on Land) is the degradation in the very dense forests and increase in the open forests leading to increased human-wildlife conflict, reduction in the flow of ecosystem goods and services to the local communities and communities living away from the forests. Similarly, the Soil Organic carbon and carbon stock of the forests has to be estimated. ISFR also states that the carbon stock in the forest of Tamil Nadu has been decreasing (2017 – 229 metric ton, 2019 – 216 metric ton, 2021 – 214.6 metric ton). In order to address this, fast-growing native trees should be planted giving more preference to the species that has greater carbon sequestration potential.

6. Ecological Restoration of Eastern Ghats

The ecological restoration of the Eastern Ghats in particular should be given more attention. As these tracts of forests are not in contiguous range, there is a high threat for degradation due to developmental pressure and the effect of climate change. The forests in the Eastern Ghats are rich in forest resources, are source of few perennial and semi-perennial streams, and other natural resources. Detailed study exclusively on the Eastern Ghats using geo-spatial technologies should be carried out to identify the priority areas where the degradation and loss of forest cover has been large. Accordingly, action

plans should be developed with scientific inputs to take up Eco-restoration activities in these regions.

7. Preference for natural forests than tree plantations

Allowing degraded natural forests to re-grow is a more effective than planting trees in non-forest areas. Protection of existing natural forest and recovery of degraded forests should be given more priority besides planting of trees. In terms of carbon sequestration also natural forests are said to store more carbon. Activities like afforestation with native & climate resilient species specific to particular agro-climatic zones shall be given priority along with soil and moisture conservation works, forest fire prevention and engagement of local communities.

8. Management of Invasive species

As per the ISFR 2021, about 1515 sq.km. are under the invasion by various invasive alien species out of which the lantana camara invasion into the forest landscape is estimated to be 1154 sq.km.. The invasive species are proving to be a great threat to the forest biodiversity in the State which requires an immediate scientific intervention with realistic documentation on the success or failure of past invasive species eradication programme under various forestry schemes. Policy for invasive species management has been developed by the state which suggests measures to be taken to manage these invasive species within the forest areas. Removal of invasive species coupled with measures to restore the native species has to be initiated. There are some success stories available within the state at Kodaikanal and Mudumalai which can be used to arrive at workable solutions for other infested areas within the forest.

9. Forest protection & notification of unclassified lands

Protecting existing forests from encroachment, forest fires and other forms of human interference is essential to maintain and increase forest cover. This can be done by increasing patrols and surveillance of forest areas. Notification of unclassified lands will also help in increasing the forest cover as the land would get legal protection on being notified as "forests". Identification of potential habitats with good wildlife population as sanctuaries, community reserves and conservation reserves is also a possible way to increase the forest cover. In this aspect, the state government has been proactive in notifying potential forests as protected areas. Sacred groves are one other constituent that contribute to the tree cover. Tamil Nadu State Land Use Research Board has taken up a study to create geo-spatial database of Sacred Groves in Tamil Nadu through detailed documentation and delineation of the existing groves.

10. Way forward

i. Periodical Data analysis - Data on forest cover in Tamil Nadu from reliable sources such as the Forest Survey of India (FSI), Ministry of Environment, Forest and Climate Change, Tamil Nadu Forest Department, and other relevant government agencies can be collected.

ii. Conduct spatial analysis - Through satellite images, visual analysis can be made on the forest cover in different parts of Tamil Nadu. This can help in identifying the distribution and density of forest cover, as well as the location of different types of forests. Forest type mapping for the state shall be carried out, which will help to identify the type of the forest that is vulnerable to the external threats.

iii. Analyze the forest cover data in a periodical manner to identify trends and patterns. This helps to understand whether forest cover is increasing or decreasing and what factors are contributing to these trends. Since it is a time series of biennial reports, monitoring of forest resource once in 5 years by comparing different parameters with the previous assessment as change, will be able to provide valuable information and will also indicate the performance of any specialized programme taken up to increase the forest cover or to improve the quality of the forest stock.

iv. Identify the factors that are affecting forest cover in Tamil Nadu, such as population growth, urbanization, agriculture, industrialization, mining, and other forms of land use change. This helps to develop strategies to address these factors and protect forest cover.

v. Assess the impact of policies and programs at the field level. Recommendations should be based on sound scientific evidence and take into account the needs of local communities and other stakeholders.

11. APPENDIX: FOREST COVER MAP OF TAMIL NADU FROM 2001 TO 2021

Figure 11.1: 2001 Forest cover map of Tamil Nadu

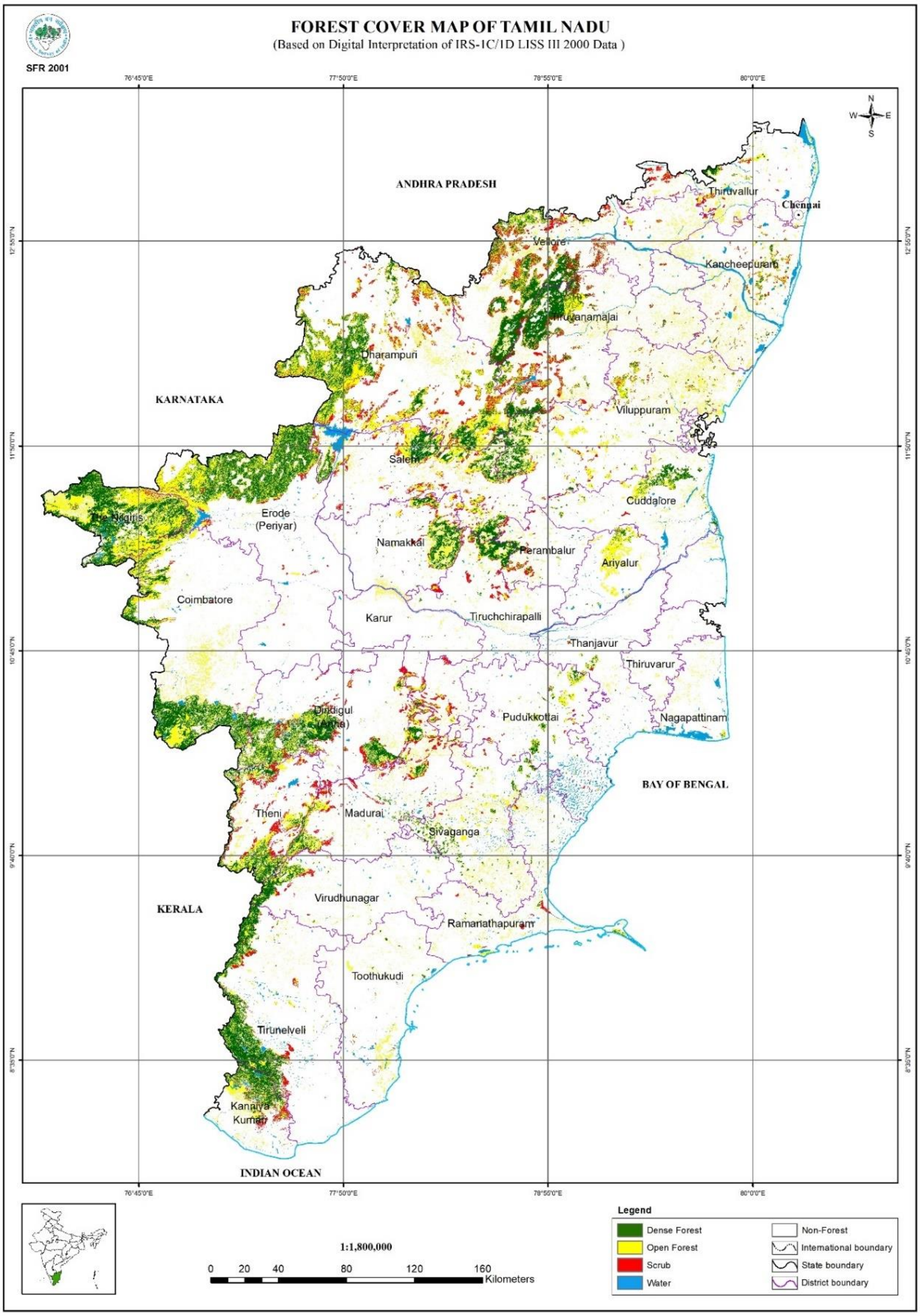


Figure 11.2: 2003 Forest cover map of Tamil Nadu

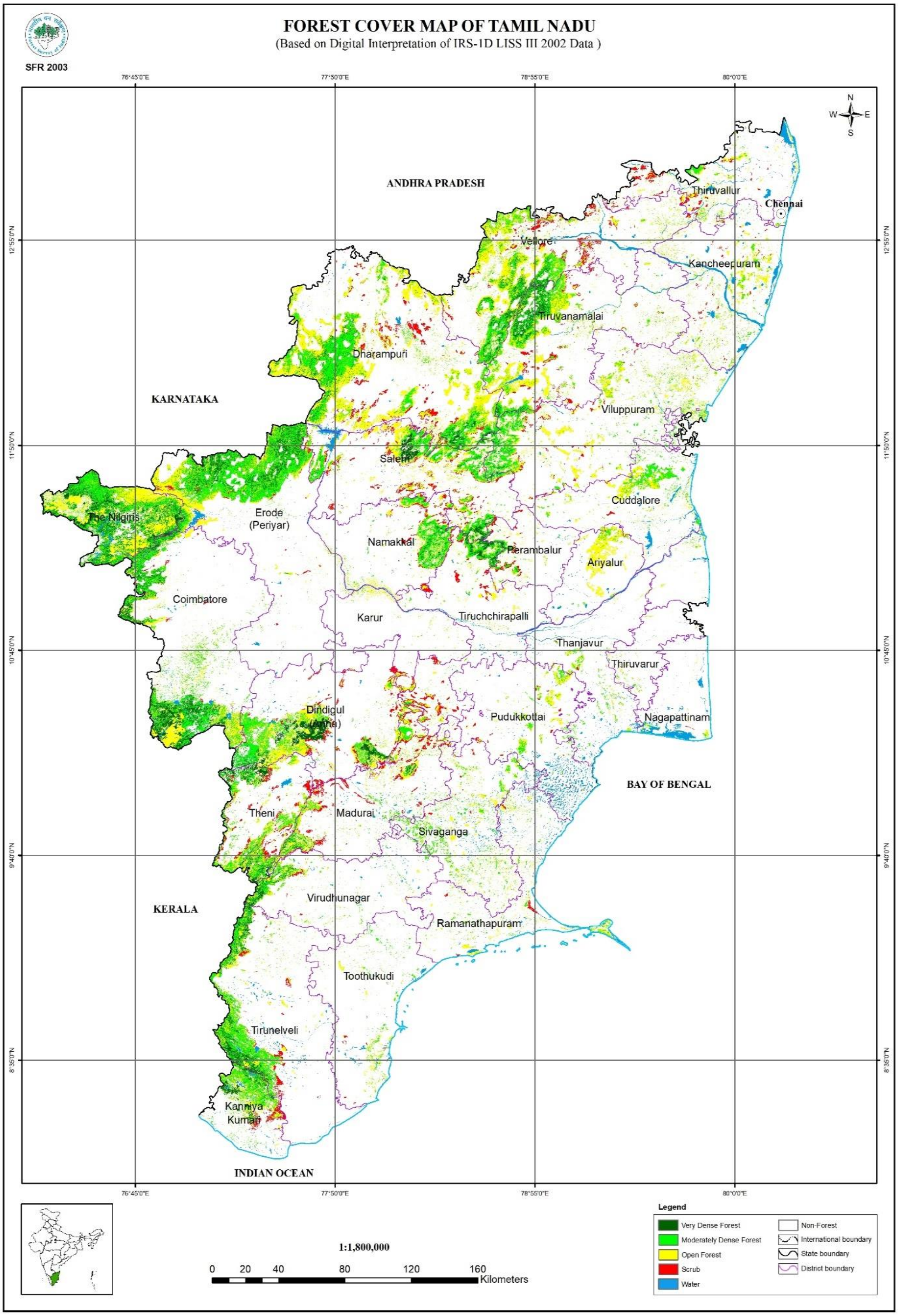


Figure 11.3: 2005 Forest cover map of Tamil Nadu

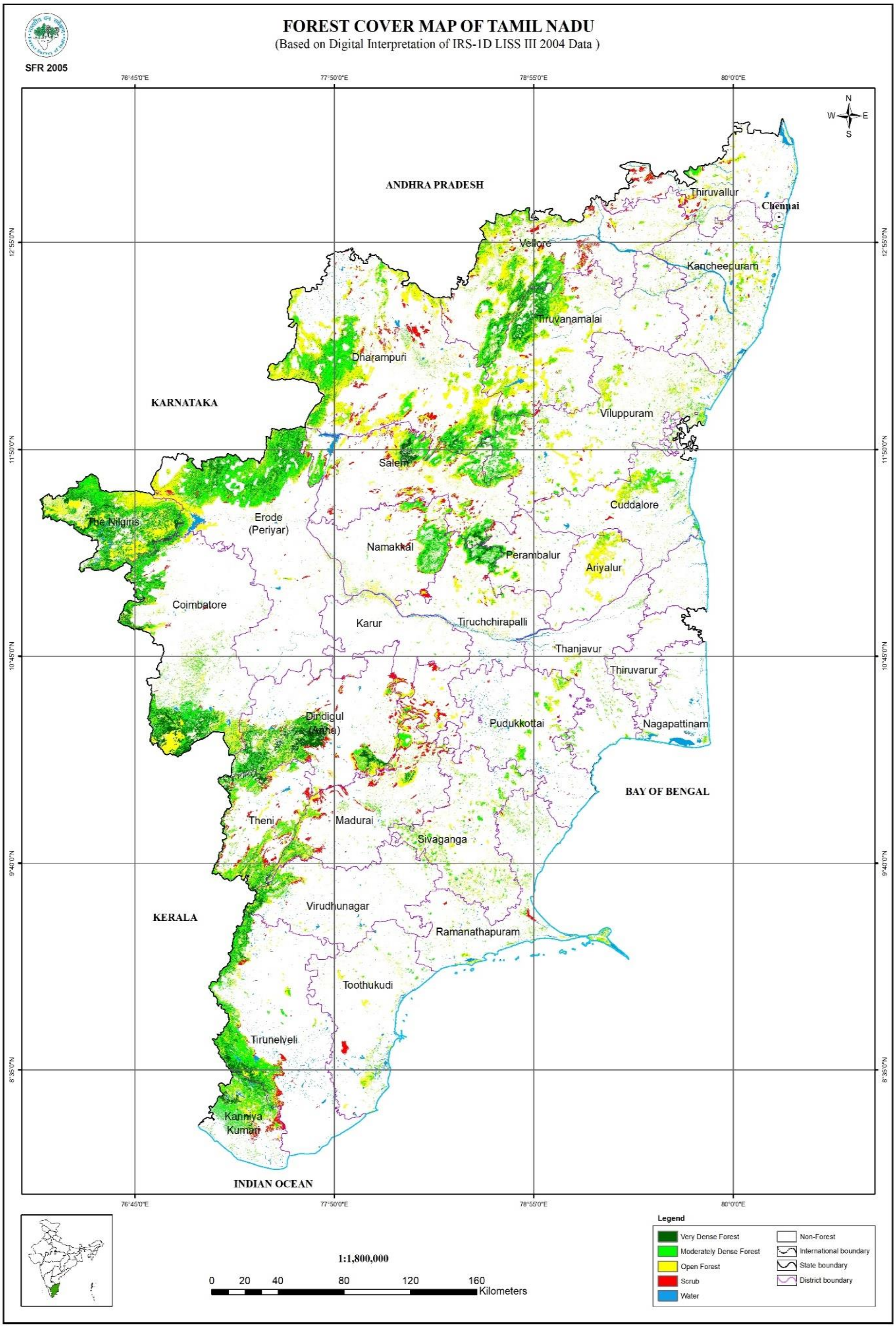


Figure 11.4: 2009 Forest cover map of Tamil Nadu

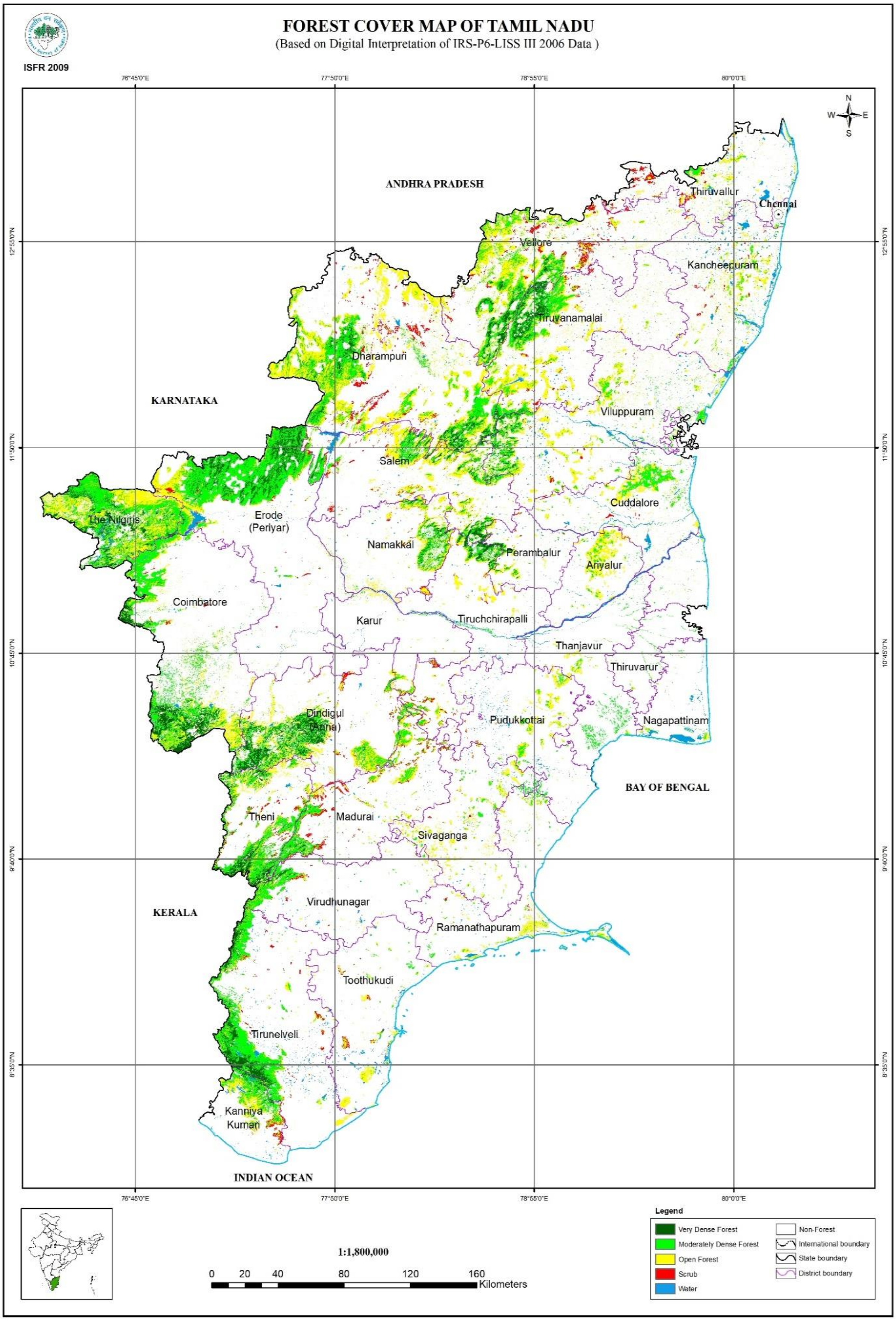


Figure 11.5: 2011 Forest cover map of Tamil Nadu

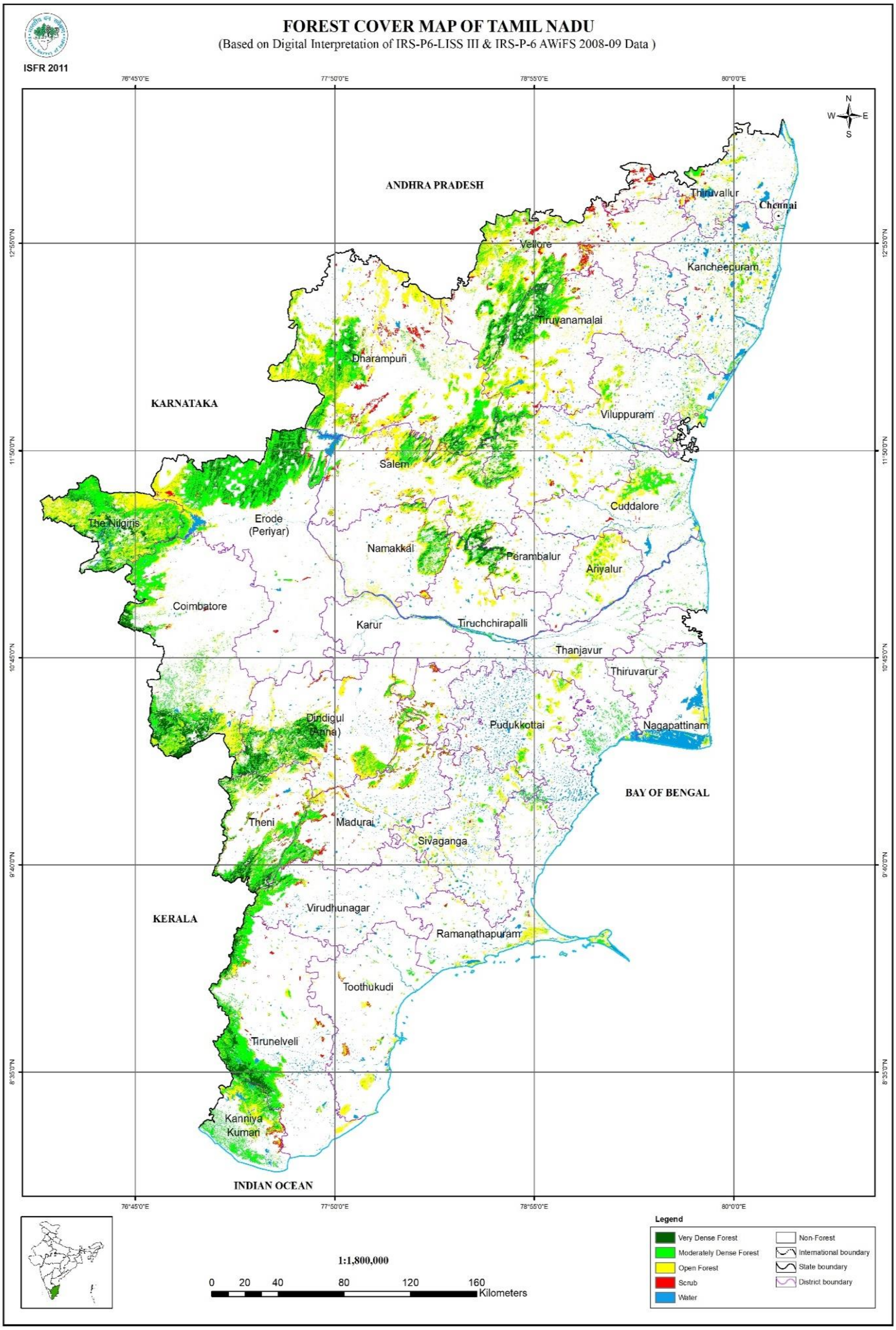


Figure 11.6: 2013 Forest cover map of Tamil Nadu

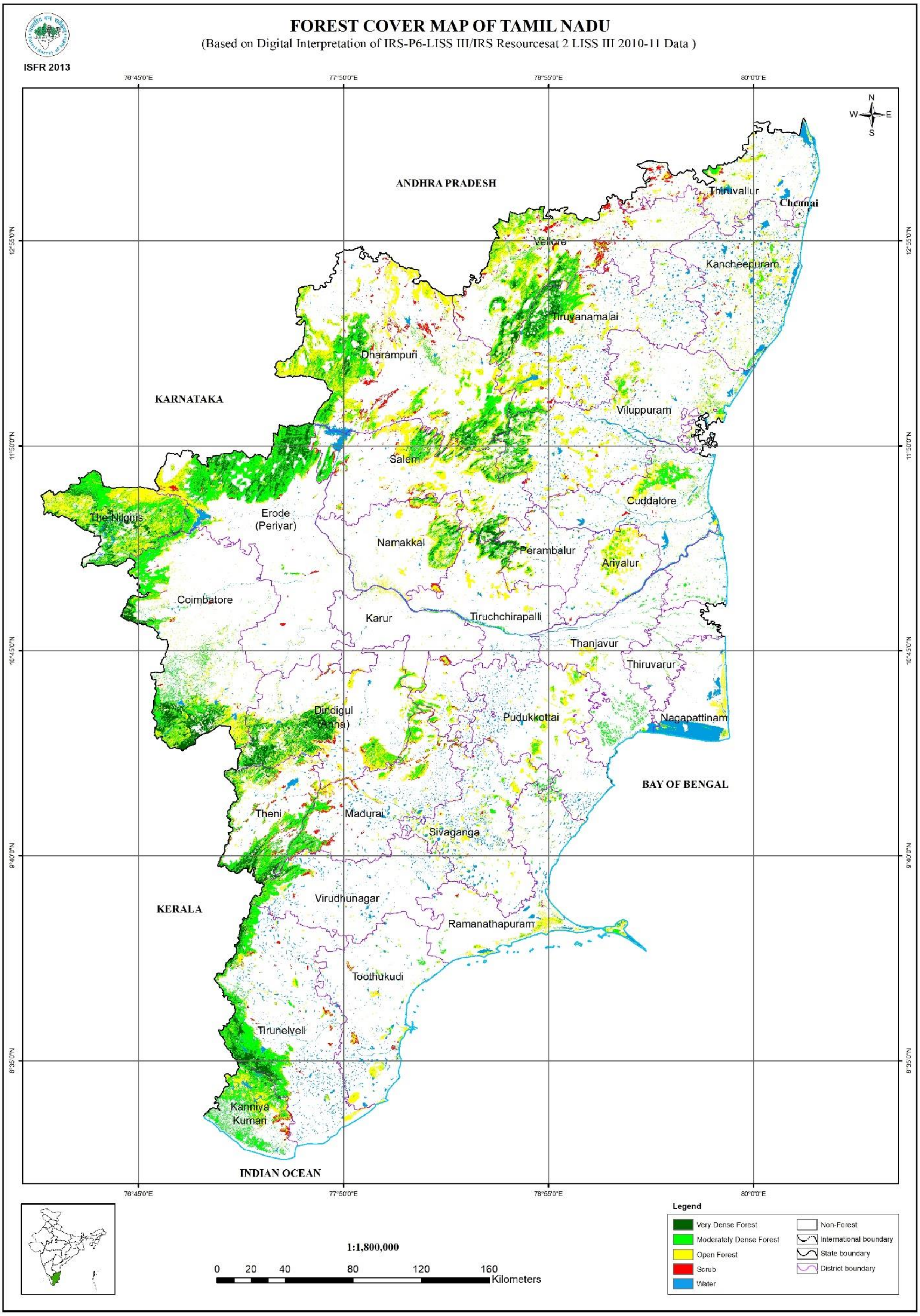


Figure 11.7: 2015 Forest cover map of Tamil Nadu

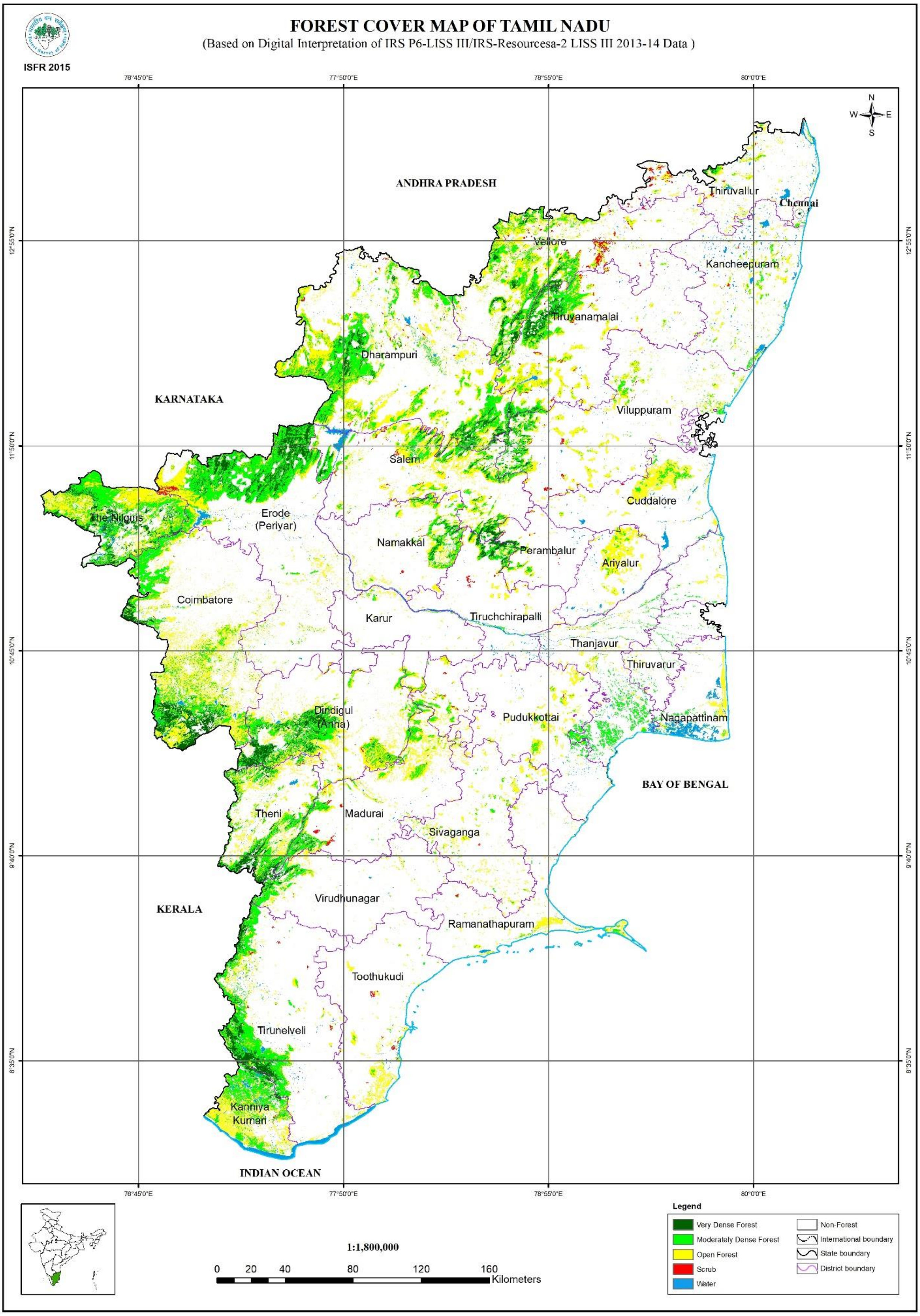


Figure 11.8: 2017 Forest cover map of Tamil Nadu

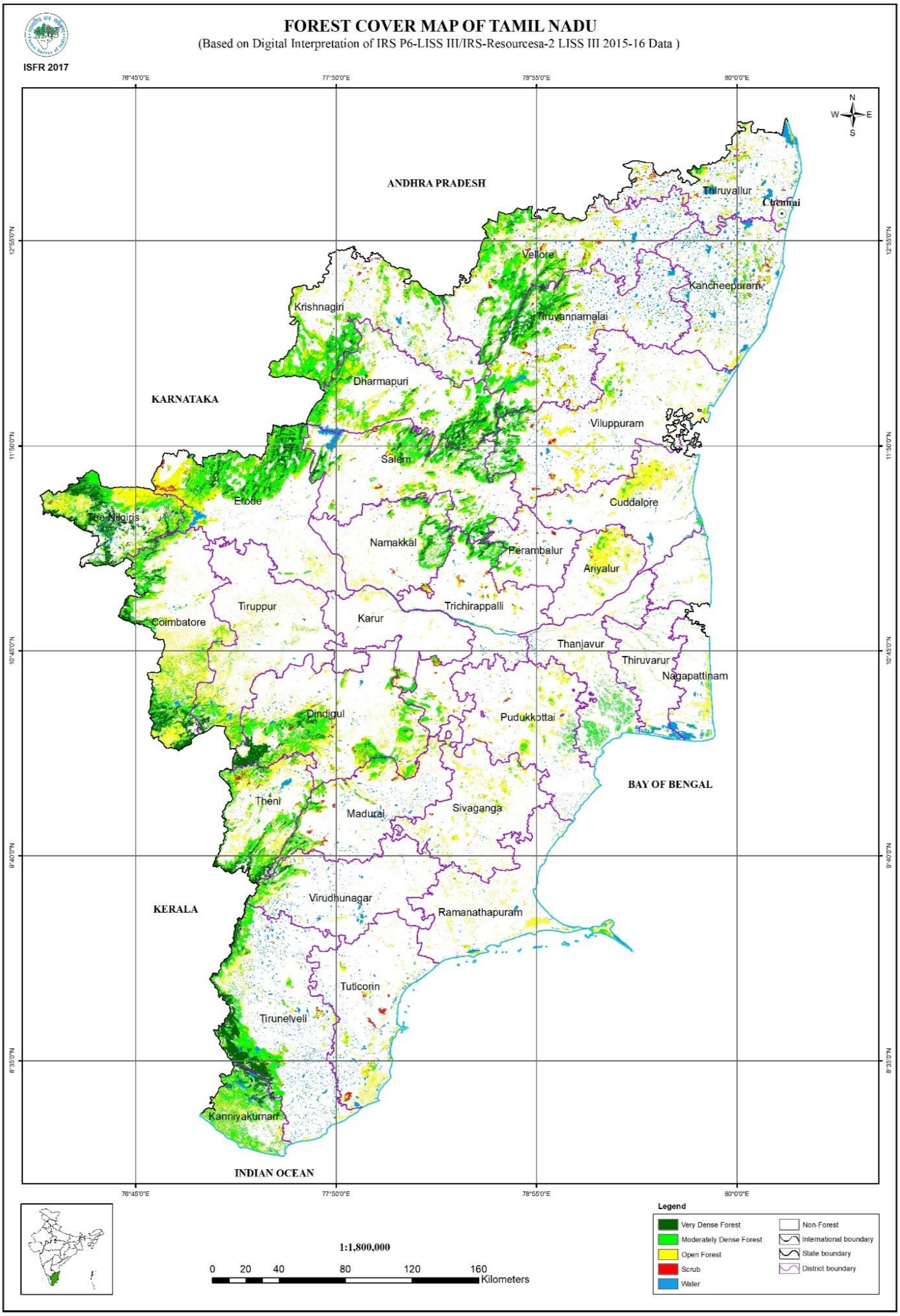


Figure 11.9: 2019 Forest cover map of Tamil Nadu

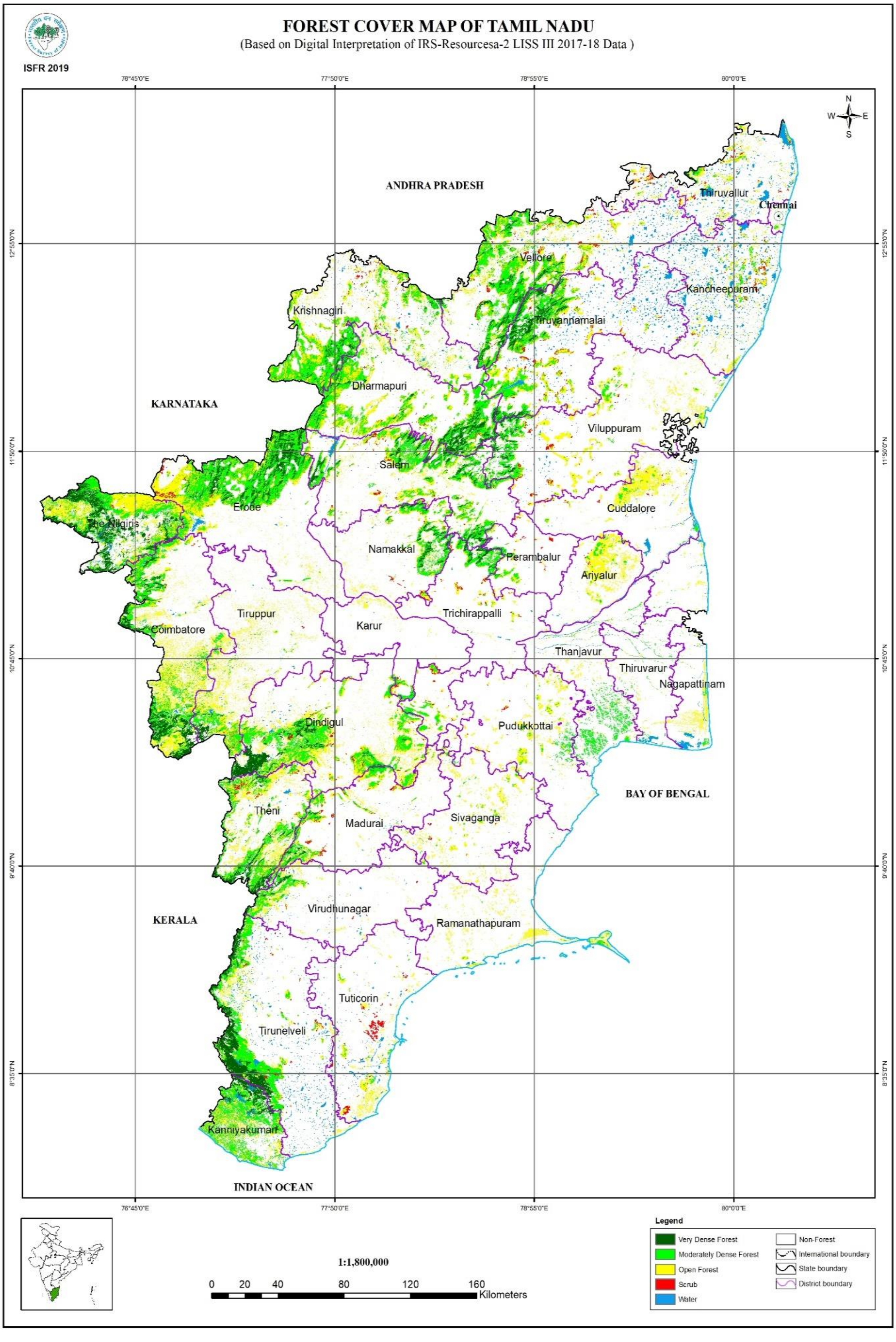
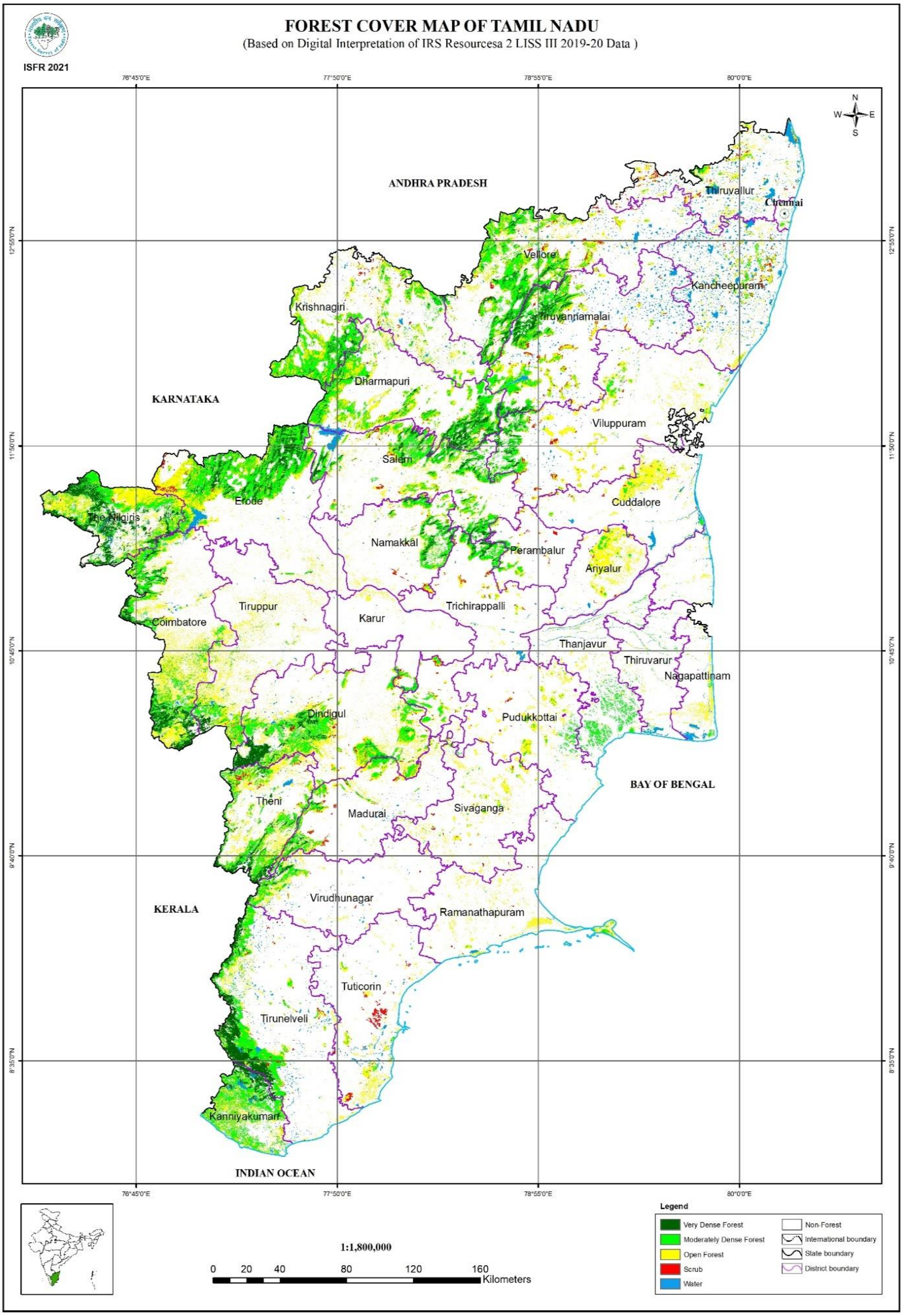


Figure 11.10: 2021 Forest cover map of Tamil Nadu



REFERENCES

1. India State of Forest Reports 1987 to 2021, published by Forest Survey of India
2. Tamil Nadu Forest Department policy notes 2001-2021
3. Atlas of Mangrove Wetlands of India, M. S. Swaminathan Research Foundation Chennai, India
4. All Forest Cover maps used in this report are obtained from FSI

ACKNOWLEDGEMENT

Our sincere gratitude to Prof. M. Vijayabaskar, Additional Full Time Member, Prof.R.Srinivasan, Full time Member and Prof. Sultan Ahmed Ismail, Part time Member, State Planning Commission for the support and guidance.

We also thank Prof. A. Ramachandran, Emeritus Professor, Centre for Climate Change and Disaster Management (CCC&DM) Anna University, Dr. Kurian Joseph, Professor of Environmental Engineering, CCC&DM and Prof. L. Venkatachalam, Officiating Director, Madras Institute of Development Studies for reviewing this report.

GLOSSARY

- **Forest Cover:** All lands, more than one hectare in area, with a tree canopy density of more than 10 % irrespective of ownership and legal status. Such lands may not necessarily be a recorded forest area. It also includes orchards, bamboo and palm.
- **Forest Area/ Recorded Forest Area (RFA):** The area recorded as a forest in the Government records. It is also referred to as "recorded forest area".
- **Mangroves:** Salt tolerant evergreen forest ecosystem found mainly in tropical and sub-tropical coastal and/or inter-tidal regions.
- **Mangrove Cover:** Area covered under mangrove vegetation as interpreted from remote sensing data. It is included in the forest cover.
- **Moderately Dense Forest (MF/MDF):** All lands with forest cover having a canopy density between 40 to 70 percent.
- **Open Forest (OF):** Lands with forest cover having a canopy density between 10 to 40 percent.
- **Protected Forest (PF):** An area notified under the provisions of the Indian Forest Act or other State Forest Acts, having limited degree of protection. In protected forest all activities are permitted unless prohibited.
- **Reserved Forest (RF):** An area so constituted under the provisions of the Indian Forest Act or other State Forest Acts, having full degree of protection. In Reserved forests all activities are prohibited unless permitted.
- **Scrub:** Degraded Forest lands having canopy density less than 10 percent.
- **Tree Cover:** It comprises of tree patches outside the recorded forest area exclusive of forest cover and less than the minimum capable area (1 ha) and up to 0.1 ha. Such small patches comprising of block, linear and scattered trees are not delineated as forest cover during interpretation of satellite data. The areas of scattered trees are computed by notional numbers.
- **Trees Outside Forests (TOF):** Trees growing outside recorded forest areas.
- **Very Dense Forests (VDF/DF):** Lands with forest cover having a canopy density of 70 % and above.
- **Unclassed Forest:** An area recorded as forest but not included in reserved or protected forest category. Ownership status of such forests varies from State to State.

TAMIL NADU STATE LAND USE RESEARCH BOARD

STATE PLANNING COMMISSION

GOVERNMENT OF TAMIL NADU

MARCH 2023